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TEXAS OBSERVERS

By JAMES H. LOGAN and OSCAR E. MONNIG.

The late Dr. Charles C. Godfrey, of Bridgeport, Connecticut, who died in 1927 while President of the American Association of Variable Star Observers, bequeathed his astronomical equipment to the Association. Among the instruments was an 11-inch reflecting telescope which Dr. Godfrey had constructed with his own hands, and this was lent to James H. Logan at Dallas late in 1927 for use in the regular variable star observing program of the Association. It was mounted at once and put into use on the night of November 27, 1927. From then until September, 1929, when Logan left Dallas and the telescope was transferred to Oscar E. Monnig at Fort Worth, 2,141 observations of over 140 variables were made and submitted in regular monthly reports to the Association.

The telescope is an octagonal wood tube of considerable weight, with a mirror of slightly less than eleven inches in diameter and sixty-seven inches focal length. Three small claws hold the mirror, which is an inch and a quarter thick, to a substantial ring bolted to a plate which constitutes the bottom end of the telescope and hinges outward, thus facilitating access to the mirror.

An elliptical flat of plane glass a half-inch thick and two inches by three inches along its axes is ingeniously mounted in a metal cylinder, attached by only one arm of stout metal to a sliding plate at the upper end of the tube. This plate also carries the eyepiece tube with its rack focussing adjustment. Two metal rings fitted with cross-wires for rough sighting are attached to the upper end of the tube, and close by the eyepiece is mounted a finder of one-inch aperture, equipped with a diagonal. This type of finder is especially handy in variable star work due to its proximity to the eyepiece of the main telescope, and even with this small aperture stars of 7th and 8th magnitudes could be seen.

The preservation of the silver surfaces of the mirrors was aided by two cotton-lined tin cups which were always kept over the mirrors when the telescope was not in use. Resilvering has been necessary several times, but a truly satisfactory coat has never been obtained, regardless of almost antiseptic care, fastidious adherence to directions, accurate temperature regulation, or experimenting with formulas. The Brashear process always deposits a bright but much too thin coat, so that it is necessary to divide the solutions and resilver several times in immedi-

ate succession, while the Lundin process deposits a satisfactorily thick but much too dull coat.

However, with only a very average silver coat, and even in the center of the residential section north of downtown Dallas, the limiting magnitude on first class nights was always close to 14. On one occasion a 14.4 magnitude star in the field of Z Cassiopeiae was held distinctly for several minutes.

The mounting of the 11-inch, constructed in 1926 of model T Ford rear axle parts at an approximate cost of $50.00, including materials and machining, was originally made to carry a home-made 6-inch re-

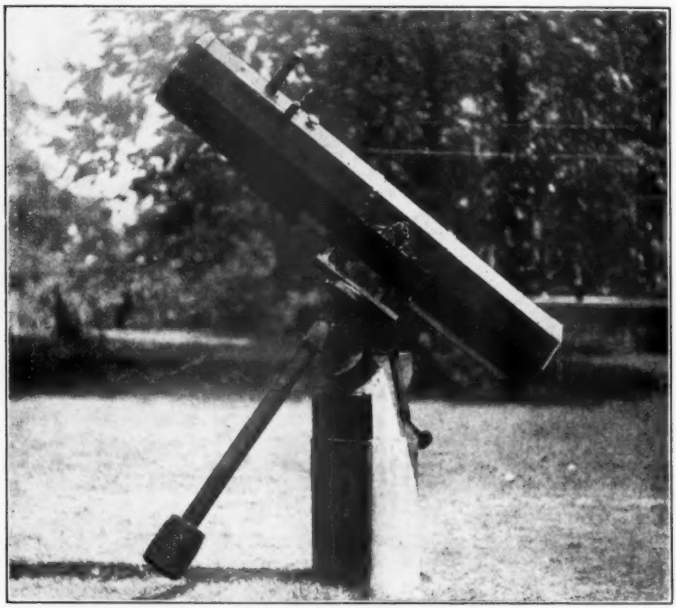


FIGURE 1.
THE MOUNTING FOR THE ELEVEN-INCH.

flector, and was somewhat overweighted and unstable for the larger telescope. Nevertheless it was satisfactory for the observation of variable stars, where extreme rigidity is not particularly necessary. In order to counterbalance the weight of the wood tube the declination axis was lengthened considerably and a concrete counterweight was attached to its end. The pier was made from a two-foot section of 12x12 "flue tile" filled with re-inforced concrete, and attached by re-inforcing bars to a bell shaped foundation sunk a little deeper than two feet into the ground. The mounting head was added as a separate part by further

re-inforcing. The pier is thoroughly steady and has given perfect satisfaction.

The telescope cradle is detachable from the declination axis, so that the tube and mirror, with accessories, could always be kept in the house. As the entire telescope proper weighed well over 50 pounds, the "setting up" exercise involved in its use was considerable. A photograph of the telescope is shown in Figure 1.

As the mounting had no circles, an observation was always carried out by using the finder to pick up a reasonably bright star near the required field, and then working in to the field with the aid of the variable star chart and the Beyer-Graff *Stern Atlas*. Besides the observation of variable stars, the telescope has been used for sun-spot photography with a Graflex camera (exposure of 1/1000 second) and for lunar photography. Good photographs were obtained of the spots which caused the aurora of July 7, 1928, beautifully visible at Fort Worth and Dallas, and seen as far south as San Angelo, Texas, (31° 29′ N. Lat.).

Beginning in January, 1928, a group of friends in Dallas and Fort Worth banded themselves together very informally under the title given them by Dr. C. P. Olivier in dealing with their meteor observations as reported by him in POPULAR ASTRONOMY: "Texas Observers." The organization does not hold formal or scheduled meetings and has no dues or officers, but acts rather as a medium through which observations are made and submitted. It stands for serious observational work, and so is the very antithesis of the usual "rocking chair" astronomical societies. Its personnel consists of Robert Brown, Oscar E. Monnig, and Blakeney Sanders, of Fort Worth; Sterling Bunch, now of Knoxville, Tennessee, but formerly of Fort Worth; and Graham D. Kendall and James H. Logan, of Dallas. These six have chosen the field of amateur astronomy as a serious hobby, and in pursuing it have obtained observations of meteors, and variable stars, and done work in celestial photography, all of which is of distinct value.

One of the first coöperative acts of this group was the lending of a 6-inch Kendall-Logan reflector by its makers to Monnig, at Fort Worth, who remounted it and used it at various public meetings as well as for amateur observing. Early in the work of the Texas Observers a 3½-inch refractor in Bunch's use, mounted on a portable stand, was used as a guide telescope in some experimental stellar photography, a 3-inch doublet of the portrait lens type being mounted in an 8x10-inch box with a plateholder and strapped onto the main tube of the telescope. This camera was later discarded due to extreme spherical aberration, but one plate taken with it showed well the nebulosity surrounding the Pleiades.

In using this equipment it was necessary to get well outside of the lights and haze of Fort Worth, and the usual place of observation was some 5 to 10 miles outside the city's limits. Usually, the telescope was set up and aligned on the pole by allowing for the distance of Polaris from the pole, clamping the telescope in declination, swinging it through

12 hours of right ascension, from the extreme east side of the mounting to the extreme west side, and correcting by halves for any error present. This is an admittedly crude adjustment, and a certain declination error was always present, especially in the exposures which ran as high as two hours. A hand slow motion of remarkable simplicity and efficiency, devised entirely by Bunch, and consisting of a stationary and a revolving pipe flange screwed on the housing and axis of the polar pipes (the mounting was constructed of pipe fittings), connected by a bolt working through pivoting taps, was used in making these exposures. It is hoped that it will be more fully described by an illustrated note to appear soon.

It was on these expeditions that the Texas Observers first became properly acquainted with the beauties of the Zodiacal Light and Gegenschein. The program of photography had originally been primarily aimed at the recording of meteors, but the unusually difficult obstacles such as the small sky area covered by the portrait lens and the uncontrollable factor of chance, discouraged this enterprise. Several nearly first magnitude meteors crossed fields being photographed in August, 1928, but none was recorded, probably because of the high ratio of aperture to focal length of the camera, 1 : 4.5.

Accordingly, an f. 3.5 Graflex camera equipped with a Xenar Schneider lens was obtained at the close of 1928 in order to make a renewed attack on the Zodiacal Light and meteors. A series of exposures in the spring of 1928, some stationary, some following, yielded no definite trace of the Zodiacal Light. Venus and Jupiter interfered considerably. Fresh attempts will be made in the spring of 1930.

With the same program of star and meteor photography in mind, a request was made early in 1929 to the A.A.V.S.O. for a star camera of wide field and high speed, such as is necessary for meteor photography. A 5-inch doublet, formerly used at Bayport, New York, by Mr. C. A. Post, was shipped to Texas by the A.A.V.S.O. in the spring of 1929.

The camera is 32 inches overall in length and has a ratio of focal length to aperture of 4.8. It photographs a circular field seven inches in diameter on 8x10 plates, and covers a field on the sky sphere of 218 square degrees, just comfortably including, for example, Cassiopeia's Chair. The scale is 1 inch = 2°.38 or 1 cm = 0°.937. The weight of the camera alone, ready for work, is thirty pounds. It was at first feared that the expense and difficulty of mounting it were too great to justify the probable results, but after much consideration it was finally agreed that the means and manner of mounting could be met.

The selection of a suitable site was difficult, for both Fort Worth and Dallas are surrounded by air-mail beacons, and a dark sky is the *sine qua non* of successful photography of the heavens. The value of the camera, guiding telescope, and mounting made it necessary to select a place where the instruments would be safe. An ideal location was finally found on a farm belonging to relatives of Robert Brown, some 15 miles south of Fort Worth, far enough in the country to guarantee clear, dark

skies, and still close enough to be reasonably accessible. As luck would have it, the Department of Commerce has since erected an air-way beacon only 3 miles from the place of the mounting, and this now interferes considerably with photography of the western sky.

FIGURE 2.
MOUNTING FOR THE POST CAMERA.

The mounting, shown in Figure 2, was constructed of model T Ford parts, the rear axle being divided and used as the polar and declination axes according to the conventional method, except that neither housing was sawed off, the bell of each being turned down. This kept intact the fittings for all bearing sleeves, and permitted full length axle shafts to be used, thus insuring steadiness. The lower ends of both the polar and declination axes were threaded with standard pipe threads; this permitted the fixing of a 2½-inch pipe flange on the bottom of the polar axis, to which was attached a bracket carrying a driving worm on a shaft. Both ends of the shaft have female threads so that the guiding handle, which terminates in a universal joint, can be screwed into the shaft on either the east or west side. The worm engages with a 96-tooth gear 6 inches in diameter, held directly on the bottom end of the

polar axis with a set screw. A close-up of the slow-motion is shown in Figure 3. Due to the considerable weight of the apparatus (the block, camera, and telescope attached to the top of the declination axis weigh about 75 pounds), this driving mechanism at the time seemed to be the only weak point in the mounting, but when the apparatus was properly balanced, it worked satisfactorily. The subsequent addition of a thrust bearing at the upper end of the polar axis gave the slow motion remarkable ease and smoothness.

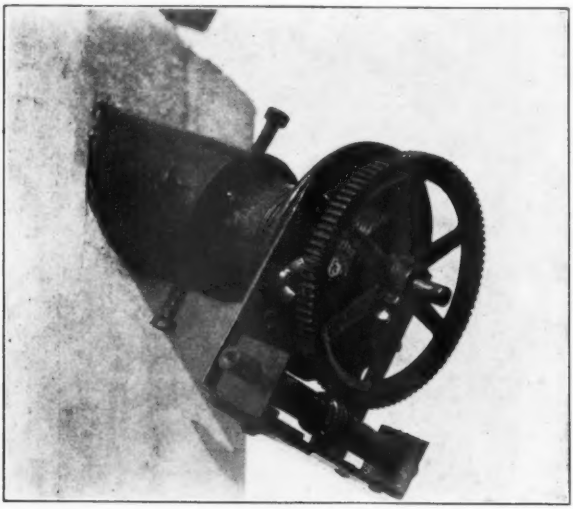


FIGURE 3.
CLOSE-UP OF THE SLOW-MOTION DRIVE.

New axles, bearings, and bearing sleeves were used. The emergency brake system of the model T Ford was converted into an adjustable friction clamp for both right ascension and declination axes. The finally assembled mounting head was set in a four-foot pier of solid concrete, similar in general plan of construction to the mounting for the 11-inch reflector in Dallas, except that two sections of 12x12-inch flue tile were used, and the well pipe housing the polar axis is set in the pier in an original way, giving greater stability, as shown in Figure 4. The polar axis was adjusted to the pole with such nicety that the error in declination, over a swing of four hours of right ascension, is less than 1′ of arc.

Threads at the lower end of the declination housing permitted the attaching of a pipe reducer, which served the double purpose of holding in the lower bearings and permitting the attachment of a threaded 1-inch pipe, on which a 30-pound counterweight can be moved up and

down, reamed out flanges on each side of the weight being used to hold it in any desired position. It would of course be better to thread the counterweight itself.

The new mounting was first put into actual service on August 10, 1929, when two plates were taken, each with two hours' exposure. Eighteen plates have been taken in all, the exposure times running from

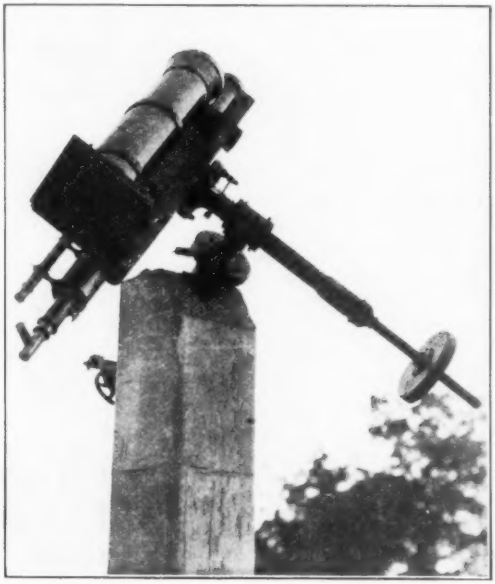


FIGURE 4.
ANOTHER VIEW OF THE POST CAMERA MOUNTING.

28^m to $4^h\,6^m$, and averaging $2^h\,14^m$. Most of the plates are centered along the Milky Way, and photographs of the star clouds in Sagittarius, Scutum, and Cygnus have been obtained. Two of them are shown in Plates VIII and IX. Two exposures show the North America Nebula, and one shows most beautifully the nebulosity, both light and dark, around Zeta Orionis (Plate VII). In December, 1929, three plates were taken showing Wilk's Comet (1929 *d*).*

Eastman Speedway and Hammer Ultra-Rapid Press plates were used. The techniques of focussing the camera and of developing the exposed plates so as to bring out all they contain are far from mastered, and it is hoped that improvement along these lines will yield lower limiting magniudes than those yet achieved, about 14.0.

*Two of these were published in the March (1929) issue of this magazine, pages 179, 180.

During the construction of the mounting for the Post camera a 4-inch Alvan Clark refractor was lent by the A.A.V.S.O. to Sanders for variable star work, and this instrument is employed for guiding. As no shelter is provided for the mounting, the camera and telescope are always brought back to town when not in use.

Following is in every case done by all observers present, working in fifteen or twenty minute shifts of hand guiding on the out-of-focus image of a star, which is kept centered on the cross hairs of a medium power eyepiece.

Besides the work outlined above, the Texas Observers have found time to bend much effort toward the popularization of descriptive astronomy, especially in the high schools and by occasional newspaper articles. In addition to collecting data and information on several brilliant fireballs seen in the southwest, they have regularly observed for the American Meteor Society. Members of the Texas Observers and their friends contributed 904 meteor observations in 1927, and 1,873 in 1928—over 29 and 44 per cent respectively of the entire number reported to the A.M.S. in those years. Many side by side observations of meteors have been made, as well as two and three station simultaneous observations. It has been definitely decided that during the summer of 1930 accurate determination of latitude and longitude will be made for the Burleson mounting.

The group has been in existence nearly two years. Too much appreciation of the A.A.V.S.O.'s interest in the work cannot be expressed, for at every turn they have been willing and ready to give help. The members of the group have built up among themselves lasting friendships, and they feel that they have developed a type of "expeditionary" astronomy without a dome which is a unique contribution.

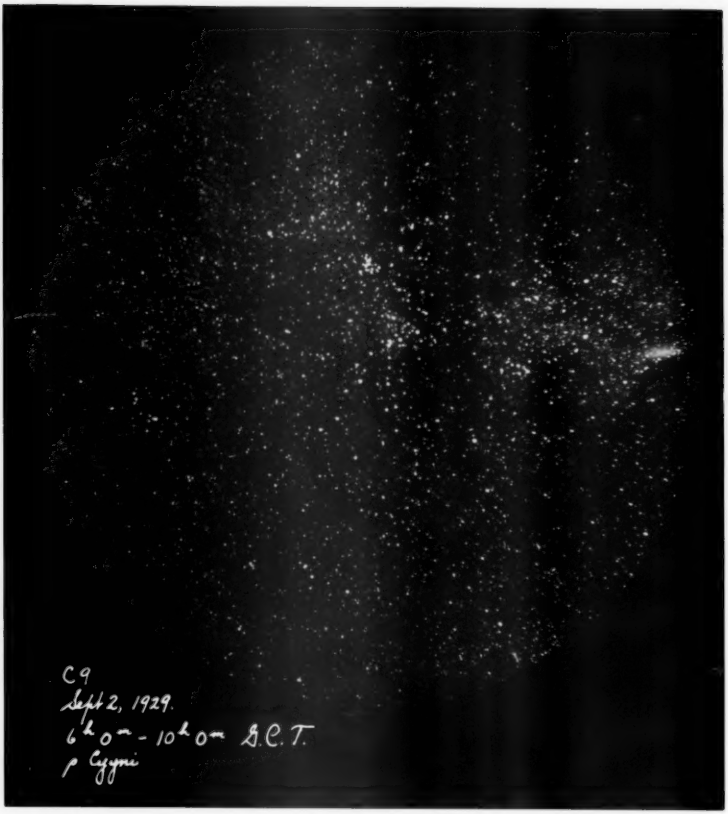
COLUMBIA UNIVERSITY, NEW YORK CITY, FEBRUARY 12, 1930.

WILLIAM OTIS BEAL

By CLIFFORD C. CRUMP.

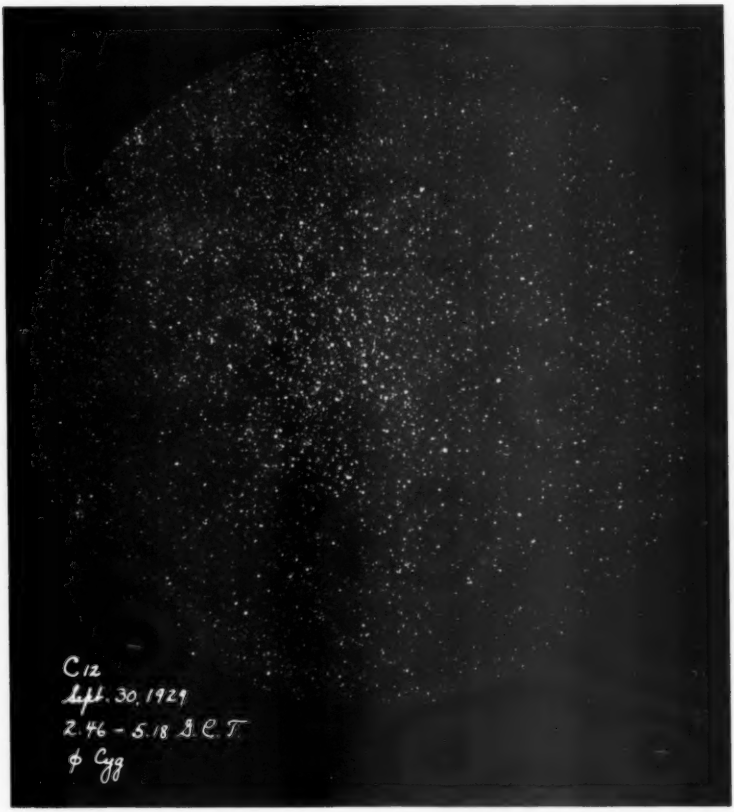
The death of William Otis Beal occurred after a brief illness on February 15, 1930. Professor Beal had been an instructor and assistant professor at the University of Minnesota since 1913, and acting chairman of the Department of Astronomy since 1928.

Professor Beal was born at Rollin, Michigan, February 18, 1874. He was graduated from Earlham College in 1896, receiving at that time the highest award of his class, the Haverford Scholarship. The following year he received the Master of Arts degree from Haverford. After a brief period as an instructor in Mathematics at Michigan State College and in the Chicago Manual Training High School he went to Illinois College where he remained until 1912. In 1926 he obtained the degree of Doctor of Philosophy from the University of Chicago, the subject of



EXPOSURE OF $4^h\ 0^m$ ON ρ CYGNI, SEPTEMBER 2, 1929, WITH THE POST CAMERA AT BURLESON, TEXAS.

PLATE IX



EXPOSURE OF $2^h\ 32^m$ *on* ϕ CYGNI, SEPTEMBER 30, 1929, WITH THE POST CAMERA AT BURLESON, TEXAS.

his dissertation being "Equations of Variation for the Orbit of Hyperion." His chief interest was in the teaching of Astronomy, but he carried on double star observations, and the investigation of periodic orbits until the time of his death.

To understand the life of Professor Beal one must have an insight into the mysticism of the Society of Friends. His life was distinguished by its simplicity and by its absolute absence of pretense. It was these qualities together with his thoughtfulness and consideration for others which made him beloved by the hundreds of students that came under his influence. His work was always thorough and painstaking. No problem was too long or too arduous for him. Whatever the work might be that presented itself he attacked it with grim courage and that great essential of all astronomical endeavor, patience. Whether the solution was a matter of days or a matter of years it made little difference to him. Once his hand was set to the task he did not look backward. Discouragement, defeat or success, whatever came as a reward he accepted it with a quiet dignity which had an aura of nobleness. When he spoke of the heavens those who heard him knew that for him they held that sense of majesty and awe which lifts the souls of men. He, too—

"—loved the stars too fondly
To be fearful of the night."

April, 1930.

REVIEW OF SUNSPOT OBSERVATIONS MADE AT ALTA, IOWA, DURING THE YEARS 1926, 1927, 1928, AND TO JULY, 1929, COMPLETING FORTY YEARS OBSERVATIONS

By DAVID E. HADDEN.

This communication gives the summary of sunspot observations since my last paper published in Popular Astronomy, **34**, April, 1926, which was for the years 1924 and 1925; also it brings to a close a series which was commenced in August, 1890, all of which were made at this place mainly with a 5½-inch refractor.

During this period four maximum and three minimum epochs of the 11½-year cycle were noted.

In discontinuing the detailed daily counts of groups, spots, and faculae, the writer knows that the work is much better done by others with larger and better instrumental equipment and at more numerous locations, so that it would serve no useful purpose to continue the work here. He will, however, continue to record the number of groups and give more attention to unusual ones and the spectroscopic appearance and activity of groups and prominences.

1926.

The decided revival of activity noted in the latter half of 1925 continued during most of this year, giant spots being observed on the disc during practically every month of the year, those of January, February, March, June, September, and October being especially large, easily visible to the naked eye and associated with magnetic storms and auroras. Severe disturbances to the telegraph and telephone companies were noted on January 26, March 5, April 14, September 8, and October 14-15, and brilliant auroras were of frequent occurrence.

1927.

The numerical results of the average number of groups and spots for this year show a slight increase, the activity noted in 1926 continued during the greater part of the first six months, but the spots were mainly small until July when larger ones were noted accompanied by bright auroras with beams south of the zenith on the night of July 21. August also witnessed some giant spots which were spectroscopically active.

Auroras and strong earth currents were noted in October and the year closed with no indication that the maximum cycle was yet at hand.

1928.

Solar activity continued all this year, with the exception of brief quiescent periods in May and the latter part of November, when only few groups were present, the average, however, for the year being only exceeded by the maxima of 1893 and 1917. Very fine large spots were on the disc in January, February, March, April, June, July, September, and November and fine trains of spots were present in January, May, July, September, and December. Much spectroscopic activity was noted in the train visible December 1-11, and extensive auroras were noted July 7 and 8.

1929.

As noted elsewhere in this paper, the detailed daily observations were discontinued at the end of July of this year, so that the period under review covers only seven months. While the activity seemed to be well maintained, the size and number of the groups were distinctly less, indicating that the maximum must have been passed during the latter half of 1928; the visual observations would seem to indicate that September, 1928, was about the peak of the cycle. Some fine spots were also present in August, October, and November.

In the following tables are given the monthly summaries of the daily observations taken from January, 1926, to July 31, 1929.

1926	No. of Observing Days	—Av. No. of— Groups	Spots	Faculae	No. of Spotless Days
Jan.	8	6.1	19.0	4.1	0
Feb.	11	4.3	21.7	3.6	0
March	11	4.5	18.4	3.6	0
April	9	3.4	11.2	4.3	0
May	11	4.5	21.8	3.4	0
June	7	5.4	28.0	3.6	0
July	8	2.5	13.4	4.4	1
Aug.	8	4.1	23.0	3.8	0
Sept.	9	4.3	20.0	3.5	0
Oct.	11	5.2	25.2	3.5	0
Nov.	5	4.0	20.0	4.2	0
Dec.	2	5.0	26.5	7.0	0

1927	No. of Observing Days	—Av. No. of— Groups	Spots	Faculae	No. of Spotless Days
Jan.	4	5.2	28.0	4.5	0
Feb.	4	6.7	46.2	5.0	0
March	6	4.8	27.5	5.0	0
April	3	4.3	40.0	3.6	0
May	4	4.5	21.5	3.7	0
June	7	4.7	22.7	4.4	0
July	10	4.6	17.1	4.0	0
Aug.	10	3.7	15.0	3.8	0
Sept.	4	5.7	25.5	3.2	0
Oct.	13	4.6	19.1	4.2	0
Nov.	5	4.8	30.6	4.4	0
Dec.	5	2.6	13.5	3.3	0

1928	No. of Observing Days	—Av. No. of— Groups	Spots	Faculae	No. of Spotless Days
Jan.	4	7.0	38.0	3.5	0
Feb.	7	5.3	25.3	3.9	0
March	11	5.9	26.1	3.6	0
April	7	5.3	27.9	4.1	0
May	14	4.6	26.8	3.9	0
June	8	5.5	37.3	4.0	0
July	11	6.3	38.3	4.3	0
Aug.	7	6.4	29.4	4.6	0
Sept.	12	4.8	32.1	3.7	0
Oct.	8	5.4	23.5	3.7	0
Nov.	10	4.4	17.5	3.5	1
Dec.	10	4.4	22.1	3.1	0

1929	No. of Observing Days	—Av. No. of— Groups	Spots	Faculae	No. of Spotless Days
Jan.	5	5.4	27.0	3.8	0
Feb.	6	5.3	27.1	3.3	0
March	8	3.9	25.5	4.0	0
April	9	3.7	20.3	3.8	0
May	9	5.2	20.7	4.3	0
June	5	3.8	16.0	3.2	0
July	7	5.7	23.9	4.3	0

Average yearly number of groups for the forty-year period.

	Average Number of Groups
1891	2.9
1892	5.6
1893	6.6
1894	5.6
1895	5.2
1896	3.2
1897	2.2
1898	2.1
1899	1.1
1900	0.7
1901	0.25
1902	0.37
1903	1.65
1904	3.1
1905	4.0
1906	3.8
1907	3.8
1908	3.4
1909	2.9
1910	1.3
1911	0.62
1912	0.36
1913	0.14
1914	0.95
1915	3.0
1916	4.5
1917	7.3
1918	5.7
1919	4.5
1920	2.4
1921	1.8
1922	1.0
1923	0.6
1924	1.23
1925	3.13
1926	4.4
1927	4.7
1928	6.5

Reviewing the observations of the forty years the following dates have been derived:

Minimum of 1889.6 to the maximum of 1893.7..... 4.1 years
Maximum of 1893.7 to the minimum of 1901.5..... 7.8 years
Minimum of 1901.5 to the maximum of 1905.9..... 4.4 years
Maximum of 1905.9 to the minimum of 1913.5..... 7.6 years
Minimum of 1913.5 to the maximum of 1917.7..... 4.2 years
Maximum of 1917.7 to the minimum of 1924.1..... 6.4 years
Minimum of 1924.1 to the maximum of 1928.7..... 4.6 years
Minimum of 1889.6 to the minimum of 1901.5.....11.9 years
Minimum of 1901.5 to the minimum of 1913.5.....12.0 years
Minimum of 1913.5 to the minimum of 1924.1.....10.6 years
Maximum of 1893.7 to the maximum of 1905.9.....12.2 years
Maximum of 1905.9 to the maximum of 1917.7.....11.8 years
Maximum of 1917.7 to the maximum of 1928.7.....11.0 years

Astronomical Observatory, Alta, Iowa, November, 1929.

THE LUNAR TOTAL ECLIPSE OF 1927 JUNE 15

By WILLARD J. FISHER.

The predictions in the *American Ephemeris,* for the lunar total eclipse of 1927 June 15, gave for the magnitude of the eclipse 1.018, the moon's diameter being 1.00. This was then to be an eclipse barely total. A projection of the eclipse, according to the usual methods, based on the data of the *Ephemeris,* is given in Figure 1. In this, NS is an hour

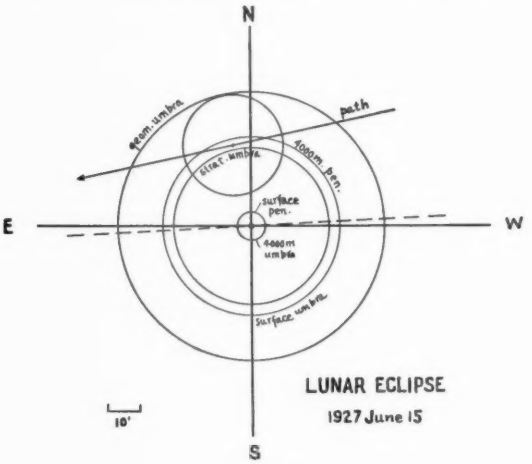


FIGURE 1.

circle through the center of the earth's shadow, EW is practically a declination circle through the same. Their intersection marks a point on the sky opposite to the sun's center as seen from the earth's center. The plane of the projection is perpendicular to the line of centers Sun-Earth, and is at the moon's distance from the earth at $8^h\ 16^m\ 26^s.4$, U.T., the moment of opposition in right ascension; this distance is, for practical purposes, constant during the eclipse. The circle marked "geometric umbra" bounds the shadow as seen from the earth's center. For computing purposes, however, and to agree with the results of masses of observations on past eclipses, the *Ephemeris* predictions make the umbra a little larger than this geometrical umbra. The direction of the moon's motion relative to the shadow is shown by an arrowhead on the straight line marked *path.* The moon is shown at mid-eclipse, at $8^h\ 24^m.2$, a short time after opposition in right ascension. Totality began at $6^h\ 42^m.8$, ended at $8^h\ 35^m.0$. The ecliptic is shown by a dash line through the shadow center. Interior circles are drawn which show the

effect of refraction in the earth's atmosphere. Thus, the circle marked *4000 m umbra* indicates the limit in the shadow plane reached by light which has passed through the atmosphere horizontally at a height of 4000 meters, having started from the limb of the sun, without crossing the line segment sun-earth. The circle marked *4000 m penumbra* indicates the limit reached by light which crosses the line sun-earth, after passing horizontally through the air at 4000 meters. The computation of these circles was made on the assumption that horizontal refraction at any level is proportional to the air density there, and at the earth's surface is 34′. (This nomenclature has been criticised, but the writer does not see how to improve it. The analogy between these "umbra" and "penumbra" boundaries and the ordinary ones is due to the method of computation, and not at all to the physical relations. It may be noted in passing that in treatment of another eclipse, that of 1924 August 14, *Harvard Circular*, No. 284, the number 2000 was throughout wrongly printed instead of 4000.) In this plot, surface umbra and 4000 meter penumbra, surface penumbra and 4000 meter umbra boundaries cannot be distinguished with the scale used.

In a previous study of the brightness of lunar eclipses[1] a very similar case had been noticed, that of 1892 November 4, in which the magnitude, by the *American Ephemeris*, was 1.100. Observations of this eclipse of 1892 were made in various parts of the world, especially in the Eastern Hemisphere. At mid-eclipse the moon's visible crescent was yellowish-white in its widest part, and dark yellow toward the horns, according to Blanchard,[2] in Hanoï, Tonkin. Doberck,[3] at Hongkong, speaks of a very bright part to the north, "giving the idea that the moon was only about seven-eighths eclipsed." Gale, at Sydney,[4] N.S.W., says that the illumination of the limb changed from NW through N to E, and was so bright as to give the impression that the eclipse was not total. Russell,[5] at Sydney, says: "The eclipse was announced to become total [at $3^h\,23^m$ G.M.T.] but here the moon did not become wholly involved in the shadow. The white strip of moon visible at the total eclipse travelled around the northern limb of the moon as the eclipse proceeded."

Computation shows that at mid-eclipse the light so brightly illuminating the moon's limb had passed horizontally through the earth's atmosphere, at some height above the earth's surface, along a line from the Adriatic across central Greenland. The light reaching the brightest part of the limb had passed over the ocean northward of the Shetland Islands. The light which reached the opposite limb of the moon, having passed at smaller heights through the earth's atmosphere over the arc mentioned, or else over the Antarctic ice, was stronger, according

[1] The Brightness of Lunar Eclipses, *Smithsonian Miscellaneous Collections*, Vol. 76, Publication no. 2751, 1924.
[2] Blanchard, *La Nature*, p. 106, 1893 I.
[3] W. Doberck, *Astr. Nachr.*, 131, p. 399-400, 1893.
[4] W. Gale, *Jour. Brit. Astr. Asso.*, 3, p. 140, 1892-3.
[5] Russell, *M.N.R.A.S.*, 53, p. 125-126, 1893.

to Russell, than that which reached a band across the moon, after passing over the equatorial Pacific and central Africa.

A footnote to Russell's observations, by the Superintendent of the *Nautical Almanac,* says:

> "The moon's center was north of the shadow's center, so that the moon's north limb was close to the edge of the shadow, and small errors in adopted values might make it visible. The diameter of the shadow is increased in a certain proportion, for one thing, but this assumed enlargement probably varies with the atmospheric conditions at the time of each eclipse."

These peculiarities of the eclipse of 1892 November 4 made it seem likely that the very similar eclipse of 1927 June 15 might display interesting peculiarities. Computation and plotting then brought out that the effective arc of the sunrise-sunset line, illuminating the moon's surface at mid-eclipse, would extend across North America from Nova Scotia to Nunivak Island, in Behring Sea, and would be centered nearly at W. 97°.3, N. 63°.75 (three-place computing), which is near the west end of Baker Lake. This lake drains into Chesterfield Inlet, west coast of Hudson Bay.

While the region traversed by this effective arc is largely wild and very sparsely inhabited, it seemed worth while to inquire whether Baker Lake was in any way accessible, and a letter was sent to Professor R. Meldrum Stewart, Director of the Dominion Observatory, Ottawa. He took hold of the matter with energy. It turned out that within a few years wireless receiving sets had been distributed to fur agents, missionaries and Mounted Police throughout the Canadian Northwest, and even in the Arctic Archipelago, so that the personnel in these widely scattered lands were in receiving communication with the world; and that programs for their benefit were being broadcast regularly by the Canadian Westinghouse Company, Ltd. Through the interest of Mr. G. E. Wendt, of the Canadian Westinghouse Co., the assistance of their broadcasting stations, especially KDKA, at Pittsburgh, Pennsylvania, was assured; and arrangements were made whereby the personnel responsible to certain organizations would be directed to make the necessary observations. These coöperating organizations and the officials who assisted by directions and orders were as follows:

Royal Canadian Mounted Police, by Courtlandt Starnes, Commissioner.

Préfecture apostolique de la Baie d'Hudson, Missions des Esquimaux, by Mgr. A. Turquetil.

Hudson Bay Company, by J. Cautley, District Manager, St. Lawrence-Labrador District Office.

Revillon Frères, by S. H. Coward, General Manager.

The Meteorological Office, Toronto, by Sir R. F. Stupart, Director, also coöperated through its regular channels, in obtaining reports from its observers at suitable points in Quebec, Prince Edward Island, New Brunswick, and Nova Scotia. The *Journal of the Royal Astronomical*

Society of Canada, Prof. C. A. Chant, editor; *Science,* Prof. J. McKeen Cattell, editor; and POPULAR ASTRONOMY, Prof. C. H. Gingrich, editor, all circulated general appeals for observations. *Science Service,* by Mr. J. Stokley, made the project known to readers of their newspaper service and to auditors of their scientific radio broadcasts. The Hydrographic Office, Washington, and the Meteorological Office, London, agreed to forward reports received from vessels at sea.

When communication was assured with the all-important Canadian observers, the line of observers was continued across Alaska nearly to Behring Sea through the coöperation of the Chief Signal Officer, Washington, by Lieut. Col. J. E. Hemphill, Acting Chief Signal Officer, U.S.A., and of the United States Weather Bureau, by Mr. Ralph C. Mize, Meteorologist, Juneau, Alaska.

Except for points near the Atlantic Coast, all the stations from Quebec to Alaska, were reached by wireless.

Several astronomical observatories in the west and southwest of the United States, and the Mexican National Observatory at Tacubaya, undertook observations of the eclipsed moon itself.

The appeal for observations in the Canadian Northwest within a hundred miles of the sunrise-sunset line was broadcast Saturday, April 23, and on succeeding Saturdays. It is quoted in the following:

> "A total eclipse of the moon will occur on June 15, 1927, the center of the eclipse being at 2:24 A.M., Central Standard Time. The sun and the moon will both be nearly on the horizon on the day and hour mentioned, at the points to which this message is addressed. Light rays passing from the sun to the moon will graze the earth's surface and pass through its atmosphere at points extending along a line drawn from a point on the east coast of Hudson Bay a short distance north of the Belcher and 'Baker's Dozen' Islands to a point on the west coast of Hudson Bay, along the south side of Rankin Inlet; thence to a point about 35 miles south of Baker Lake; thence to the Arctic Circle on Deese Bay in Great Bear Lake, and passing through a point about fifty miles north of Good Hope on the Mackenzie River, and thence westerly into Alaska. It is therefore of great scientific interest to know as exactly as possible what the weather conditions are at that particular time at points near this line. Baker Lake is the most important point of all, and the astronomers would appreciate any special efforts to procure observations there. Please report condition of sky, overhead and all around; distribution of color and glows; distribution, species and quantity of clouds; if convenient, the temperature, barometric pressure and direction and velocity of wind. Please note that a completely overcast sky is as interesting and important for the present purpose as an entirely clear one. Remember the time, June 15, 2:24 A.M., Central Standard Time. . . . Observations should be taken within a few minutes of this time, if possible . . . "

Requests of a similar tenor, though differing in form, went out to the meteorological observers in Quebec, Prince Edward Island, and Nova Scotia, and to the United States Army Signal Corps observers and Weather Bureau observers in Alaska.

The broadcasting was entirely successful, both in Canada and in Alaska. Reports were received from the following stations and observers, on the sunrise-sunset line or within a hundred miles of it:

CANADA.

Collegeville, N. S.	Hugh A. McLean.
Whitehead, N. S.	William Feltmate, Observer.
Charlottetown, P. E. I.	J. A. Clark, Supt., Dominion Experiment Station.
Chatham, N. B.	J. C. Cassidy, Observer.
St. Jules de Cascapedia	Rev. Ph. L'Italien.
Clarke City, P. Q.	E. E. Blaine, Gulf Pulp and Paper Co.
Nepisiguit Falls, N. B.	C. B. Hills, Supt., Power Plant, Bathurst Co., Ltd.
Richmond Gulf Post	W. A. Dinwoodie, Hudson Bay Company.
Chesterfield Inlet	Rev. L. Ducharme, Roman Catholic Mission.
Rankin Inlet	M. A. Joyce, Staff Sergeant, R. C. M. Police.
Port Harrison	Revillon Frères, observer not named.
Baker Lake Post	R. C. Stewart, Revillon Frères, Post Manager.
Fort Good Hope	E. R. Gowen, Hudson Bay Company.

ALASKA.

Eagle	E. Turnbull
Fort Egbert	W. H. Glasgow, Observer.
Circle	C. M. Chenoweth, Sgt., Signal Corps, & Weather Bureau.
Fort Yukon	J. W. Curlee, Staff Sgt., Signal Corps, & Weather Bureau.
Fairbanks	P. L. Chamberlain, Corporal, Signal Corps.
Livengood	K. A. Van De Water, Corporal, Signal Corps.
Rampart	C. Anderson.
Hot Springs	H. Swarburg, Corporal, Signal Corps.
Tanana	Miss J. M. Howard, Observer.
Fort Gibbon	C. T. Toback, O. I. C., Observer.
Ruby	W. N. Growden, Sergeant, Signal Corps.
Nulato	W. L. Curry, Observer.
Iditarod	C. A. Besecker, Staff Sergeant, Signal Corps.
Holy Cross	M. F. Huhndorf, First Class Private, Signal Corps.
Bethel	Miss C. E. Wilkin.

It will be noted that there were numerous reports from the Atlantic and Pacific ends of the effective arc of the sunrise-sunset line, and that there were great gaps in interior Labrador, on Hudson Bay, and from Baker Lake to the MacKenzie River. Even so, this first attempt of the kind is to be regarded as successful, and the result is highly creditable to the heads of organizations named above, who made the attempt possible, and to their subordinates, who took so much pains to get the observations. Thanks are especially due to Professor R. Meldrum Stewart and Mr. G. E. Wendt, for their energy and initiative; and to Staff Sergeant M. A. Joyce, R.C.M.P., and Mr. R. C. Stewart, Post Manager for Revillon Frères, for whom the procuring of a few minutes observations meant two or three days journey with dog teams into the wilds of the Northwest.

Figure 2 is from a photograph, by Mr. Stewart, showing sunrise over Baker Lake, June 15. The observations reported later mention "heavy black clouds toward the sun," and a clear streak near the horizon; these are well shown in the photograph, though no doubt somewhat weakened in reproduction. The sun bears about NEbN. The eclipsed moon was behind the camera.

The following table gives the observations at all points near the sunrise-sunset line in Canada and Alaska, nearly in order E to W. On these follows a letter from Sir R. F. Stupart, Director of the Meteor-

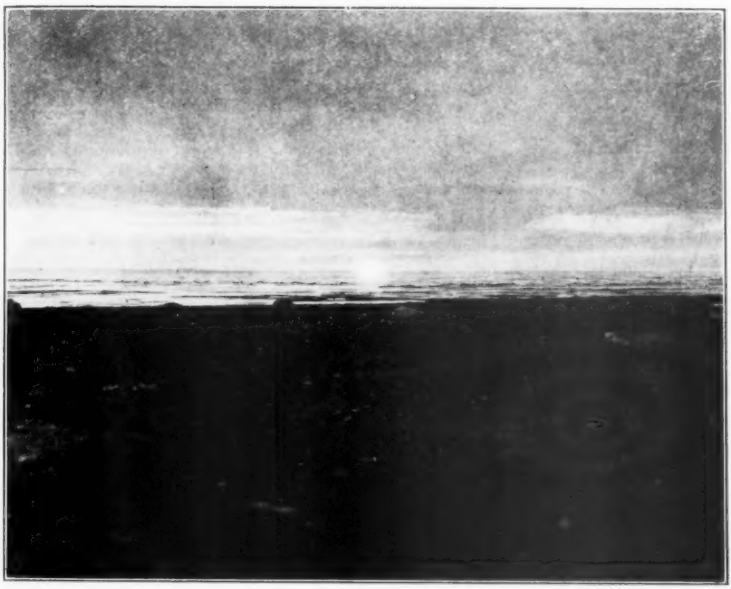


FIGURE 2.

ological Office, Toronto, bearing on probable conditions in the uncovered gaps in Canada. The number following the station's name gives the number of miles distance of the station from the plotted sunrise-sunset line; + means away from the sun, —, toward the sun.

WEATHER OBSERVATIONS, 1927 JUNE 15.

Place	Conditions; mid-eclipse, unless otherwise stated.
	CANADA.
Collegeville, N. S.	Overcast. Slight break to NE. Moon not visible. Perfectly calm. Max. 54°, min. 40°.
Whitehead, N. S.	Completely overcast. Perfectly calm. Max. 64°, min. 33°.
Charlottetown, P. E. I. +10	Moon completely hidden by clouds until it set. Above, horsetail clouds; below, cirro-stratus. The sun rose clear of clouds. Calm, 30.10 in, 45°.
Chatham, N. B. +75	4 A.M. Sky clear overhead and in the east; S to W to N, sky about 4/10 covered with stratus clouds. Moon not visible. Light air from N. 29.88 in, 45°.
Nepisiguit Falls, N. B.	Overhead, from NE to SW and to horizon NW, clouded, more dense toward the horizon. Moon could not be seen. Very light NW; 29.5 in, 35°.
St. Jules de Cascapedia +40	Clear, no clouds, no wind. 36°.
Clarke City, P. Q.	Upper clouds cirro-cumulus, lower clouds cumulus. Moon hidden behind the heavy, dark lower clouds. Wind very light all night, NW.
Richmond Gulf (+5 to +30)	Beautiful clear night. Moon below hills at 2:28 E.S.T.

Chesterfield Inlet —70	Eclipse could not be seen on account of clouds. Splendid sunrise. Sky very red at horizon north; overcast over, and with showers at the south. Wind west, 2 mi/hr. 29.98 in, 35°, max. 38°, min. 36°.
Rankin Inlet —10	Weather was so thick and cloudy that nothing unusual was observed. . . . the sun was not visible until after 6 A.M. Slight breeze SSE; max. 36°, min. 35°.
Port Harrison	3:20 A.M. [E.S.T.], moon fully eclipsed. Dark red glow in S. Dark in W with a few long narrow clouds in NW. Yellowish glow in N, with fog-banks coming up. Light red glow in NE with fog-banks obliterating the rising sun. Yellowish glow in E. Dead calm, 30°.
Baker Lake —25	1:10 A.M., faint shadow started to cover the left lower side of the moon. 2:26 A.M., total eclipse . . . Heavy black clouds toward the sun, fleecy clouds overhead and clear sky to the S. No wind, 37°.
Fort Good Hope +30	The sun was disappearing just below the horizon. Clouds a few degrees above the horizon being red. At zenith black clouds with cirrus in several places. To the S dark clouds covering the horizon. Could not see the moon at all. Wind SE; 29.70 in; dry 63°, wet 57°.
	ALASKA.
Eagle +85	11:45 P.M., (W 135°). Raining—cloudy, rainy night. Light S wind; 29.81 in, dry 56°0, max. 62°2, min. 56°0.
Fort Egbert +80	No sky visible, raining. Wind S. steady, light 28.99 in, 61°.
Circle —20	¾ cloudy; raining. Wind, SE, strong, steady; 29.13 in, steady; 58°, falling. Around sun, just setting, sky very brilliantly lighted.
Fort Yukon —75	¼ cloudy, strato-cumulus. Reddish glows on upper cloud-bank, in SE dark slate color on horizon. Unable to see moon on account of cloud-bank. Sky clear overhead. Wind N, light, steady; 29.38 in, steady; 67°, steady.
Fairbanks +20	Totally clouded, heavy clouds. Wind NE, light, steady; 60°, steady.
Livengood —40	¾ clouded. Wind SW, light, steady; 62°, falling.
Rampart —50	Nearly clear, a few scattering clouds in SW.
Hot Springs —15	¾ cloudy, medium gray clouds, light showers. Wind SE, light, steady; 77°, steady.
Tanana —50	11:30 P.M. (W 150°). Cumulo-nimbus clouds spread along the southern horizon; eastern half, mauve and rosily luminous alto-cumulus clouds. The moon was not clearly visible at any time. 29.74 in, rising; max. 84°, min. 49°. People disappointed in not being able to see the eclipse.
Fort Gibbon —50	¾ cloudy, sky dark, large dark clouds, indications of stormy weather. Wind NE, moderate, unsteady; 67°.
Ruby —70	¾ cloudy, white clouds scattered. Calm; 60°, falling.
Nulato —110	Totally cloudy, heavy black storm clouds. Wind N, light, steady; 56°, falling.
Iditarod +30	Totally cloudy, rain clouds. Wind SE, light, steady; 67°.
Holy Cross +25	Totally cloudy, light clouds, dark blue in E. Wind SW, moderate, increasing; 58°, falling.

Bethel +75	Sky bluish gray, large areas had a streaked appearance. [About the sunset point] appeared the usual red sunset glow. Wind W, about 6 mi/hr all the time; 50° to 49°. Barometer rose about 0.02 in.

Director Stupart's letter follows:

> . . . I would say that according to our weather charts for June 15th last, the following cloud conditions prevailed on that date.
>
> Northern Quebec partly cloudy to cloudy with probably light showers as far north as Lake St. John from there northwestward to Hudson Bay clear to partly cloudy; over Hudson Bay likely to be mostly cloudy, and westward to the MacKenzie Valley partly cloudy to cloudy. Over the Yukon probably clear in morning and becoming cloudy in afternoon and evening.
>
> I also state cloud conditions as reported from several northern stations.
>
> Dawson: morning clear, cloudy to partly cloudy in afternoon and evening.
>
> Mayo: morning clear, evening cloudy.
>
> Fort Simpson: morning cloudy, evening cloudy.
>
> Port Nelson: morning cloudy, evening cloudy.
>
> Moose Factory: clear both morning and evening.
>
> Lake Mistassini: partly cloudy both morning and evening.
>
> Lake St. John region: clear in morning, partly cloudy to cloudy afternoon and evening with probably some light showers.

Figure 3 is a map showing the sunrise-sunset line, and the stations reporting. These are indicated by circles, marked as on the U. S. Weather Bureau Daily Weather Map, thus: an open circle, clear; a half shaded circle, partly cloudy; a completely shaded circle, cloudy; and with arrows flying with the wind. The probabilities in the great gaps, according to Director Stupart, are given in words, not in symbols; and two of the Meteorological Office stations, Lake St. John and Lake Mistassini, are indicated in the region between the St. Lawrence and Hudson Bay, but without wind arrows. The absence of a wind arrow in other cases means *calm*. A few Canadian stations near the east coast, and Port Harrison, were not plotted, as not being marked on any available maps.

The observations and the map show that over most of the effective arc of the sunrise-sunset line there was sufficient cloudiness to prevent any light from passing through the lower atmosphere to the moon. In spite of its favorable position in the northern half of the shadow, the moon was not definitely visible at Collegeville, Whitehead, Charlottetown, Chatham, Nepisiguit Falls, Clarke City, Chesterfield Inlet, Rankin Inlet, Fort Good Hope, Eagle, Fort Egbert, Fort Yukon, Tanana, Nulato, Iditarod, and Holy Cross. It was visible at Richmond Gulf, Port Harrison, and Baker Lake, as the reports definitely mention it. By three-place computing, using parallax and refraction, the moon at mid-eclipse should have been visible wholly or partly at Chatham, Richmond Gulf, Eagle, Circle, Tanana, and Bethel, if with a clear horizon, and barring hills. At many points the reports do not mention the moon.

The sky was so fine at Richmond Gulf as to make it probable that rays through the lower atmosphere there could reach the moon. It was

FIGURE 3.

possibly also sufficiently clear at Port Harrison for similar penetration. The description of the sky and the photographs at Baker Lake indicate that penetration there would be hindered by the heavy black clouds toward the sun and the fleecy clouds overhead.

We may conclude that light rays could not penetrate the lower atmosphere and reach the moon's surface anywhere along the effective arc of the sunrise-sunset line, except in the region immediately east of Hudson Bay. So that any observed peculiarities of the earth's shadow as seen on the moon must on the whole be interpreted with exclusion of the atmosphere up to perhaps 2000 m.

On the same map are marked the positions of stations where observations of the eclipsed moon itself were made. Beginning at the east, these are, with the observers:

Cambridge, Mass.	W. J. Fisher, Harvard College Observatory.
Baltimore, Md.	A. E. O. Munsell, Munsell Research Laboratory.

Washington, D. C.	Professor F. B. Littell, Naval Observatory. Rev. E. C. Phillips, S.J., Georgetown College Observatory.
Mandeville, Jamaica	G. H. Hamilton (POPULAR ASTR., **35**, p. 510-511, 1927).
Slippery Rock, Pa.	Professor R. A. Waldron, Slippery Rock Normal School.
Havana, Cuba	Professor W. H. Hoffman, Finlay Laboratory.
Techny, Illinois	Dr. Stephen Richarz, Professor of Geology.
Tucson, Arizona	P. C. Keenan and A. B. Newborn, Steward Observatory.
Phoenix, Arizona	Miss Margaret Stuteville, age 13.
Mt. Wilson, Calif.	W. S. Adams, (*Annual Report*, 1927, and *Pub. Astr. Soc. Pac.*, **39**, p. 227-228, 1927). Also several members of the Observatory staff.
Mt. Hamilton, Calif.	Several members of the Observatory staff. (*Pub. Astr. Soc. Pac.*, **39**, p. 223-226, 1927.)
Union, Washington	E. V. Johnson.

Time observations on the passage of the shadow across craters, etc., were made by Fr. Becker, at La Paz, Bolivia. Rain prevented all observation at the Mexican National Observatory, Tacubaya.

It is curious that so few amateur astronomers in the southwestern United States reported on this eclipse, in spite of the wide publicity given the appeals for observations.

Abstracts of the reports on observations of the eclipsed moon follow. In these, *air mass* means ratio of mass of air between the observer's eye and the moon's center to the mass of air in a vertical column. It is usually practically equal to the secant of the zenith distance. Square brackets indicate insertions by the writer. This table does not include any data on the results of instrumental work not visual.

VISUAL OBSERVATIONS OF THE ECLIPSED MOON, 1927 JUNE 15.

Cambridge, Mass. 1:07.5 (W 75°) [air mass 2.8]. The penumbra became visible in field glasses (x4) as a slight shading on the SE limb. The disk was entirely clear, but the sky was hazy.

1:21:10; the shading extended halfway across, in field glasses. Disk entirely clear.

From this time on the moon was entirely hidden by clouds, except for about 1/3 min at 2:39, when the shadow was about two-thirds across, and the copper color was plain, through a thin cloud, in field glasses.

Washington, D. C., U. S. Naval Observatory. 1:31 (W 75°) [air mass 2.4]. Darkening of east limb visible to naked eye, not visible in telescope (alt-azimuth, 5 inch, x 50).

1:41; darkening noticeable in telescope.

1:43; limb, where shadow is coming on, disappears (5 inch).

1:49-3:00; no detail visible in shadow. [Air mass at 3:00, 3.7.]

[No detail is reported as visible in the shadow with Galilean binoculars, 2⅛ inch x 3+, at any time 2:07 - 4:26; but at]

3:15; [air mass 4.2], somewhat clearer. Total phase begins. Last spot of light about 10° west of vertical point of moon. This vicinity remains comparatively bright. At the opposite limb is a much darker area. No detail visible, except very general areas. Limb opposite bright area almost invisible. Color shades from bright yellow to deep copper and practically black. [Also at]

3:20; same as above. [Returning to earlier time]

2:14; binoculars, shadow quite black. No detail visible in shadow, outline of limb visible only a short distance in the shadow. Shadow practically the same color as the sky, namely, black.

2:32; binoculars, [air mass 3.1]. Outline can be traced all the way around in the shadow. Shadow nearly black with faint reddish tinge. Copper color.

2:48. A narrow, bright region, about 1′ wide all around moon, dark and light part, on the disk. Also halation effect from bright area.

2:53. Looks darker and redder in segment just opposite the small illuminated

segment. [3:15, 3:20, quoted above]

3:56, [air mass 7.0]. Fairly clear. Even distribution and gradation of light from the bright area, near the vertical point to the dark lower limb. Coppery tinge.

From 4:00 on, the moon was almost completely hidden by clouds.

General Notes. The sharpness of the shadow, and the intensity of the color, were surprisingly greater in the binoculars than in the 5-inch telescope . . . During totality the moon seemed to be considerably darker than usual for a total eclipse.

Washington, D. C., Georgetown College Observatory.

Until shortly before totality the portion of the moon within the umbra was very dark, but at 7:55 (U.T.) the whole surface of the moon became suddenly brighter, and all the main configurations could be clearly discerned with a 3-inch telescope. This sudden brightening was due probably to a lessening of the haze at the place of observation, but this does not seem sufficient of itself to account for the entire change. . . . The color of the eclipsed moon was almost pure gray, no tinge of red or copper hue being noticed by two observers, though a third observer reported a slight ruddiness. Shortly after mid-eclipse the moon sank into thick haze . . .

Mandeville, Jamaica. 7:14 Greenwich Civil Time [air mass 1.6]. With a half-tone illustration, from photograph.

. . . though mentioned as a total one in the *Nautical Almanac*, could, I believe hardly have been considered such . . . here in Mandeville there was never what might be called a complete dimming of the disk. The accompanying photograph shows woolly line of demarcation. This last was very visible to the naked eye, and showed as an intense coppery red band. A small pocket telescope of 9/16 inch aperture and x 4 showed it even better; but the 12-inch reflector of 9 ft. 10 in. focal length with which the photograph was taken, visually diffused this appearance to such an extent and showed so much detail over the whole surface of the moon, that with a power of 120 . . . no definite dividing line . . . atmosphere for the whole time was exceedingly clear.

Slippery Rock, Pa. [At mid-eclipse, air mass 4.6]. . . . very clear over the whole sky. The red color was of a dull orange. Some people with me described it as a dull red. No spots or blotches seen by any member of the party, either with or without instruments. The red color was barely visible through the 5-inch telescope x 100. The lower powered field glasses [x 3] brought it out best of the instruments. There was very little color visible on the edge of the shadow nearest this illuminated edge. . . . The maria were visible at all times, more easily visible with the naked eye. The telescope was necessary in order to locate the two larger craters. These were visible as dark spots . . .

Havana, Cuba. Wonderfully visible here. [No instrument mentioned.] Observed every half hour, 12:30 - 4:00 . . . When I came out about 3:00 or 3½ [at 3:15 W 75°, air mass 2.4] when the eclipse was almost total and there was a small rand piece illuminated, then I saw that the whole dark part showed a very beautiful red color, which . . . I called "blood red". [At mid-eclipse, air mass 5.7.]

Techny, Illinois, N 42° 07′, W 87° 48′.5. Weather conditions were excellent, but the common impression was that the moon was at no time wholly eclipsed. As soon as the bright shine on the right (western) limb disappeared, the upper limb became bright and remained so for the duration of totality . . . The whole surface of the moon was well observable during the totality, shining in a red light.

Union, Washington. [At mid-eclipse, air mass 3.1.] Telescope, x 60, aperture not stated. Sky practically clear during the eclipse. Red tinge to naked eye, same tinge throughout the eclipse. In telescope, no color noted. No spots or blotches noted crossing the moon; lunar markings faintly visible for about ¾ of the surface when it was being covered; as it went into the total [phase] all markings disappeared. . . . At 1:00 A.M. (W 105°) the eclipse remained the same.

In a study of the brightness of lunar eclipses[6] the writer has pro-

[6] The Brightness of Lunar Eclipses, 1860-1922, p. 2-3.

posed and applied a three-step scale for rough expression of visual observers' data, as follows:

"Grade 2. When the naked eye sees the spots on the eclipsed moon, or the seas and other detail can be seen with hand instruments—opera glasses, field glasses, spy glasses.

"Grade 1. When instruments of aperture 2 inches up to 6 inches are necessary to show detail on the eclipsed surface. This includes ordinary stand telescopes, porch telescopes, etc., and some fixed observatory telescopes.

"Grade 0. When apertures of six inches or more are necessary. This covers the larger part of fixed observatory instruments."

In assigning a grade to this eclipse of 1927 June 15, two difficulties arise.

The intervening air mass at mid-eclipse should be considered in weighing observations. Now the observations which mention visibility or invisibility of details on the moon's surface were made largely in the northeastern United States, where the air mass was relatively large on account of the moon's low altitude. Prof. Littell at Washington, at 3:15 (W 75°) reports, (binoculars) "no detail visible, except very general areas." At the other side of the continent, Mr. E. V. Johnson, Union, Washington, says, "as it went into the total phase all markings disappeared." But the means of observation used by him are rather uncertain. Prof. Littell says in general, "During totality the moon seemed to be considerably darker than usual for a total lunar eclipse."

On the other hand, the report from Slippery Rock says, "The maria were visible at all times, more easily with the naked eye."

Father Phillips, at Washington, says that at 7:55 U.T., "all the main configurations could be clearly distinguished with a 3-inch telescope"—probably, then, not with the naked eye or hand instruments.

The observations in the southwestern United States, where the moon was high, were not visual, and so cannot be expressed on a visual scale.

On the whole, the writer decides for grade 1 for this eclipse, though Slippery Rock indicates grade 2. The evidence is rather contradictory, and the grade is a compromise.

The second difficulty is, that the moon was so near the edge of the shadow as to make the marginal illumination very bright.

The reports from Mandeville and Techny agree on the extreme brightness of the outside limb, and are very similar to those of several observers of 1892 November 4. It did not seem that the moon was ever wholly eclipsed. One would say that the gradation, from such a bright edge to an interior so dull that the lunar markings there were hardly, if at all, visible, must have been very rapid.

It should be noted that in this eclipse the general northerly location of the maria was favorable to their visibility.

Comparing the data of this eclipse with those of 1892 November 4, it is plain that the brightness of the northern limb of the moon was very

great in each, but that the grade 0 for the latter[7] is more definitely justified than is grade 1 for this one. In 1892 the important arc of the sunrise-sunset line was centered on the ocean, while this time it was on land. Then the moon as a whole seems to have been darker, but we know nothing of the cloud conditions along the effective arc. However, though in 1927 the penetration through the lower 1000 m or perhaps 2000 m of the atmosphere was on the whole prevented or much hindered, the intensity of illumination just within the shadow edge seems hardly to have been affected. In other words, the brightness of the outer shadow depended very little on the lower 2000 meters of the atmosphere in these two eclipses; which was to be expected on theoretical grounds of refraction, illustrated in Figure 1. The inner shadow, reached only by light penetrating between the surface and 4000 m height, was apparently very dark in this eclipse, and also in 1892. Then Gale's 8.5-inch reflector failed to show any detail except near the northern and western limbs during the total phase.

The eclipse of 1903 April 11 stands in interesting contrast to these two. The position of the moon at mid-eclipse was similar to that of 1927 June 15, but the eclipse was partial, magnitude 0.973, nearly total. There were many observers, no one of whom was able to see any detail within the shadow, with or without instruments. This eclipse followed closely the great dust eruptions of Pelée and Santa Maria.

SUMMARY.

The lunar eclipse of 1927 June 15 offered the very unusual circumstance that at mid-eclipse the effective arc of the sunrise-sunset line extended across North America, where civilized people could make observations and be reached by radio.

Through the coöperation of various organizations and persons, persons near this arc were advised in time, and observations of weather and sky conditions were made at 13 points in Canada and 15 points in Alaska, at about the time of mid-eclipse.

Visual observations of the eclipsed moon were also made at a number of points in the United States and the West Indies.

The observations on the sunrise-sunset arc showed that the lower layers of the atmosphere up to perhaps 2000 m were blocked with clouds, and could contribute little in illuminating the eclipsed moon.

The observations on the eclipsed moon show that the outer edge of the shadow at this eclipse, magnitude 1.018, was very bright, so that some observers thought the eclipse not to be really total. The interior of the shadow was quite dark, with somewhat conflicting evidence.

The brightness of the eclipse is graded 1 on a scale 2, 1, 0.

It is noted that the gradation from great brightness was very rapid; that the maria, which serve photometric purposes, were placed so as to be readily seen; and comparisons are made with the very similar eclipse of 1892 November 4, and the nearly total eclipse, similarly placed but very dark, of 1903 April 11.

[7] Brightness of Lunar Eclipses, p. 16.

THE TRANS-NEPTUNIAN COMET

By WILLIAM H. PICKERING.

The *Lick Observatory Bulletin* No. 421 containing the report of Messrs. Bower and Whipple on this object has just reached me, and I feel as if there could now be no doubt, based in part also on my own computations of possible planetary orbits, but that this object is simply a comet. Had it been announced when discovered, as is customary, we should doubtless now know its orbit very completely, but such unfortunately was not the case, and we shall probably have to wait another year before we know the semi-major axis and the argument of the perihelion with certainty. In the mean time the comet must be growing steadily fainter, but can probably be photographed for a few years longer,—at least we hope so.

It is certainly a most interesting body on account of its unusual brilliancy. No previous comet has been followed, much less discovered, that was more remote than Saturn. That means that this comet is sixteen times as bright as that one, if both were self luminous. It is therefore doubtless exceptionally massive for a comet, probably even equal to one of our larger asteroids, that is to say possibly 1/10,000 the mass of our Earth. It is easy to show that there is not a vestige of evidence that it has perturbed either Uranus or Neptune. It never had a chance. A portion of its orbit, based on Dr. Miller's computation, in coöperation with the Lowell observers, is shown in Figure 1. The length of the whole orbit is seven times the diameter of the orbit of Neptune, the largest continuous circle marked *N*. The orbit of the Earth is shown at the center, and the three dotted circles marked *O*, *S*, and *P* show the orbits of the three undiscovered, but strongly suspected planets, the eccentricity of the two outer orbits being unknown. The dates attached to them have not before been given. The maximum perturbation of a known planet can only occur immediately after its conjunction with the unknown perturbing body. Thus Uranus in 1841, as shown in the figure, was perturbed by the assumed planet *O*. Again in 1904 Neptune was perturbed by the same body.

If now we compare the longitude of Uranus in 1870 with that of the comet, we shall find that they are on opposite sides of the Sun. In 1900 Uranus had begun to overtake it, but in 1930 the comet was far away from it again. In case Dr. Miller's orbit is anywhere near correct, then this at once settles the question that the comet is not Lowell's so-called planet *X*, because his whole computation was based on its perturbations of Uranus. Similarly Neptune in 1870 is far ahead of the comet, in 1904 it is a little nearer to the location that the comet occupied in 1900. In 1915, shown on the figure by the two cross lines, one on each orbit, it was still a little nearer, but yet too far to seriously affect

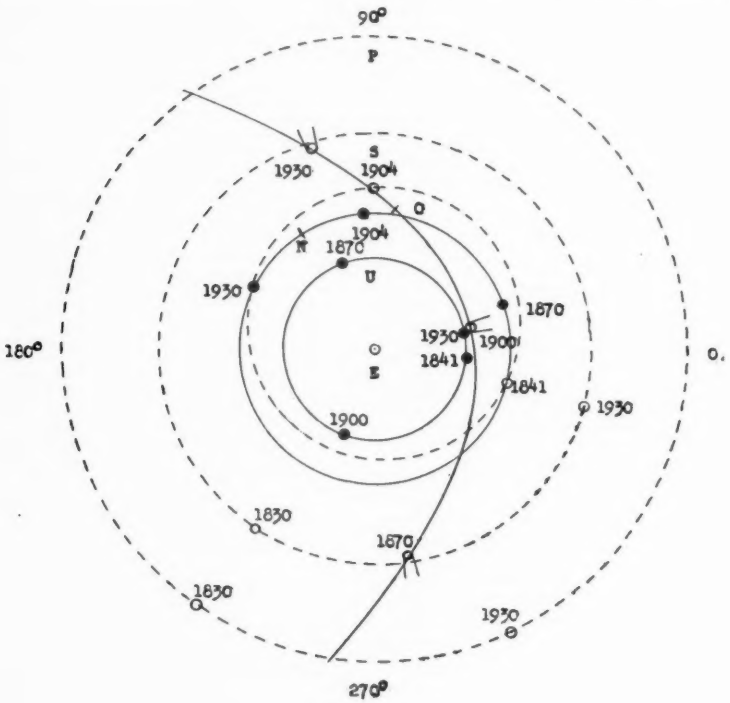


FIGURE 1.

it, and in 1930 the two bodies are again far apart. In 1902 and 1904 Neptune was violently pulled forward and then backwards by some unknown body, but it was evidently not the comet. If the comet were sufficiently massive it might have helped to pull it backwards, but it could never have pulled it forwards, as we found was the case, because it was never ahead of Neptune. It is quite clear, therefore, that the comet is not identical with planet *O*. There is no reason to imagine that this comet differs from any other comet, except that it would appear to be somewhat more massive, and all the excitement about a new planet seems to be a case of much cry and very little wool.

A rather interesting question comes up about the classification of this object. If its period proves to be less than 1200 years, and more than 200, it may be placed in Class *C*, Type *P*, and associated intimately with the unknown planet *P*. Messrs. Bower and Whipple suggest a period of only 264 years. During the last century comets of this group were coming at the rate of one in every five years, and promised soon to outstrip in number those associated at any one time with the planet Jupiter.

But the last one appeared in 1905, and since then either none have come, or what is more likely, they have come, but owing either to their faintness, or to moonlight, or to some other cause, such as their perihelia occurring on the other side of the Sun, they have not been detected. Now a very promising specimen has appeared, which we hope will soon be followed by others. In order to become a full-fledged member of this group, however, not only must the period lie within the limits stated, but the comet's aphelion must be located in that third of the sky that lies within 20° of the orbit of planet *P*. The aphelion according to Dr. Miller's orbit lies in longitude 192° 10′, latitude +17° 14′, and therefore about 24° distant from the orbit, and on the northern side of it. For the formulae see POPULAR ASTRONOMY, 1928, **36**, 276 and 361. A small reduction in his longitude of perihelion would bring the aphelion of the comet's orbit within the required 20° of the orbit of the planet. It is so near now that we may expect that a further alteration in the semi-major axis, which is also obviously doubtful, will reduce his period from 3190 years to less than the required 1200. Both of these changes are predicted on the strength of our earlier research, but probably we shall not know definitely with regard to them before next winter.

The group of comets in Class *A*, Type *N*, those which are associated with the planet Jupiter, is still the most important well defined group in the sky, but it is only a matter of a few years before those of Class *C*, Type *P*, will greatly exceed it in numerical importance. Jupiter is adding to his family five or six new comets at each revolution, but owing to their close proximity to his orbit during the outer portion of their revolutions, many are being deflected away into other orbits, and still others passing within the Earth's orbit are gradually dissipated and dispersed by the action of the Sun. It must have been many years ago that this constant increase and loss balanced one another, and now we find that in the period from 1876.0 to 1901.0 there were 25 different comets which were detected in Jupiter's family. In the following twenty-five years 13 of these were not observed at all, although all of them were carefully looked for, and every one of them should have come to perihelion at least four times, and some of them five. We may thus fairly say that most, if not all of them are permanently lost. On the other hand to replace them 10 new ones appeared, so that in the period 1901.0 to 1926.0 we had 22 different comets visible. Six of these Encke, Pons-Winnecke, Faye, d'Arrest, Temple (2), and Temple (3) are old standbys, that we have known for sixty years or more. The remaining six of the previous quarter century we have known now for thirty or more years. It will be interesting to see which of these twelve survive, and appear during the present quarter century.

Turning now to Class *C*, Type *P*, their primary appears to be a smaller planet than Jupiter, with a mass rather greater than that of Neptune, and located at present far in the south. Otherwise it would have been detected long ago. It is probably of magnitude 11 to 12. Its mean distance as determined both by its two perturbations of Uranus, and also

by its own cometary following, cannot exceed 70 units. At such a distance its period would be about 600 years, and its associated comets would have periods, as above noted, ranging from 200 years to 1200. It is therefore evident that only a very few of them can have appeared during the past fifty or sixty years, when accurate and vigilant cometary search began. Should the Flagstaff comet prove to belong to this family, it will bring their number up to 16, with one additional comet, number 369, only just outside the 20° limit, which by definition should contain all the aphelia. Thus we see that it may be said that Jupiter is clearly running a losing race, but it will be interesting to see how soon it will be overtaken,—perhaps in thirty years.

PRIVATE OBSERVATORY, MANDEVILLE, JAMAICA, B. W. I., APRIL 30, 1930.

AMERICAN ASTRONOMICAL SOCIETY

REPORTS OF OBSERVATORIES 1928-1929

(Continued from page 285.)

ASTROPHYSICAL OBSERVATORY

SMITHSONIAN INSTITUTION
WASHINGTON, D. C.

The year has been principally notable for the satisfactory continuation at field stations of observations for the study of the variability of the sun; for the satisfactory completion of the critical statistical investigation of the results obtained at Table Mountain, so that hereafter Table Mountain observations may be definitively reduced by field observers; for the excellent accord found between definitive results of Table Mountain and Montezuma (stations 4000 miles apart in opposite hemispheres) in their indications of solar variability; for the apparent confirmation of three definite periodicities of approximately 11, 15, and 26 months in solar variation; for the discovery of a new method of measuring the atmospheric ozone, and its influence on solar constant observations; for the repetition of a former investigation of solar and terrestrial absorption lines and bands in the solar spectrum, but with nearly threefold richer results; and for the observation of the distribution of energy in the spectra of eighteen stars and two planets.

C. G. ABBOT, *Director.*

SPROUL OBSERVATORY

SWARTHMORE COLLEGE
SWARTHMORE, PENNSYLVANIA

It is with deep regret that we report the death of the Reverend Walter A. Matos, who in addition to his duties as Rector of the Protestant Episcopal Parish of Swarthmore, was a volunteer observer at the Ob-

servatory. This title measured by his accomplishments is altogether too modest. He took an active and definite part in the observing program for the determination of stellar parallax. He also was in charge of the telescope on some of the evenings each year when the Observatory was open to visitors. His association was stimulating, his influence potent, and his companionship both pleasant and inspiring.

Messrs. Miller and Marriott were engaged in the study of certain of the eclipse plates made by them at various eclipses, and in preparation for observing the eclipse of 1929. The college sent an expedition, of which Mr. Miller was the Director and Mr. Marriott a member, to observe the eclipse of May 9, 1929. They were stationed at Takengon, Sumatra.

During the past year 443 parallax plates were secured on 93 observing nights. *Sproul Observatory Publication,* No. 10, was issued. This contains the fifth list of fifty parallaxes and the parallax of the Pleiades as determined by various methods. The observations of fifteen additional fields have been completed and five of these measured and reduced.

The proper motions of about 400 faint stars have been measured by Mr. Kovalenko. About 200 are published and the rest are under reduction. The proper motions are derived from the measurements of two early parallax plates of the Boss star regions and of two new plates. The interval of time between the parallax plate and the new plate is from eight to fifteen years. The results of these measures have been published by Mr. Kovalenko (*A.J.*, 916, 922, 926). Some of these series will prove useful in determining the relative masses of binary stars.

Mr. Pitman published (*A.J.*, 918) a paper on "The Masses and Absolute Magnitudes of Binary Stars." The paper brings together these data for 104 visual systems and 30 systems which give double-line spectra. When arranged according to spectral class, the visual systems, eclipsing systems, and spectroscopic binaries are consistent and show a steady decrease in mass as well as magnitude in passing from the "early" to the "late" spectral classes.

JOHN A. MILLER, *Director.*

OBSERVATORIO ASTRONOMICO NACIONAL

TACUBAYA, MEXICO

The principal work in the Observatorio de Tacubaya, Mexico, is devoted to the conclusion of the Astrographic Catalogue. During the interval July, 1928-July, 1929, the plate-constants for zone —14° have been computed and another volume of the Catalogue is being printed.

Magnetic observations along Lower California were made in July, 1929, which provided material for an approximate drawing of the isogonic lines for 1930.

During the winter, observations of small planets, shooting stars, and planets were made by the writer and the two assistants.

The Observatory will be in future a department of the University of Mexico.

JOAQUIN GALLO, *Director.*

VAN VLECK OBSERVATORY

WESLEYAN UNIVERSITY

MIDDLETOWN, CONNECTICUT

During the year the stellar parallax program has been continued, concentrating chiefly upon faint stars of large proper motion. The number of plates secured was 562. Seventeen fields have been measured and reduced. Some results of especial interest were reported to the society, viz:

Barnard's Star	$\pi = +0''.558 \pm 0''.005$
61 Cygni (brighter component)	$\pi = +0''.296 \pm 0''.008$
61 Cygni (fainter component)	$\pi = +0''.302 \pm 0''.008$
17 Lyrae C	$\pi = +0''.132 \pm 0''.009$
Star in Black Hole in Sagittarius	$\pi = -0''.007 \pm 0''.007$

The comet discovered by Mr. Stearns in March, 1927, moved rapidly into high north declination and has been followed at the Yerkes Observatory and elsewhere continuously up to date (July, 1929).

Records of weather conditions along the path of the total eclipse of the sun of August 31, 1932, have now been received for five years. The results from all stations from Hudson Bay to Cape Cod give an average percentage of clear sky at eclipse time for the last two weeks of August and first two weeks of September of somewhat more than 70% and there seems to be very little variation in the weather conditions along the whole line. Full details from seven years' observations will be published in 1931.

Messrs. Slocum and Sitterly have, as usual, given four year-courses and one half-year course, with a total enrollment of 111 students.

Mr. Stearns has devoted all his time to the research program.

FREDERICK SLOCUM, *Director.*

WASHBURN OBSERVATORY

UNIVERSITY OF WISCONSIN

MADISON, WISCONSIN

Work on the new mounting of the 15-inch refractor was continued in the University shops. The chief item of construction was a new photo-electric photometer for the 40-inch refractor of the Yerkes Observatory, which was installed in the summer of 1929.

The 15-inch refractor was used on ninety-one nights by Messrs. Stebbins and Huffer for the regular photo-electric program. Observa-

tions were continued when advisable on the stars mentioned in last year's report. The tests on red stars were completed, and new measures were undertaken on a list of spectroscopic binaries with unknown periods and of miscellaneous other stars. A study of the variation of the atmospheric extinction with spectral type showed little difference in this effect in the range from B to K stars.

During the year considerable experimentation was done by Mr. J. C. Cavender, research assistant, on the amplification of photo-electric currents.

JOEL STEBBINS, *Director.*

YALE UNIVERSITY OBSERVATORY

NEW HAVEN, CONNECTICUT

Miss Carolyn Gesler was promoted from computer to assistant. Miss Marie Kelly resigned as computer and Miss Marion Hall was appointed in her place. A grant from the A.A.A.S. permitted the appointment of Miss Helen Roche, to assist in measuring and reducing photographic plates obtained at our Southern Station.

Miss Barney, Mr. Brown, Mr. Schilt, and Mr. Schlesinger attended the meeting of the International Astronomical Union at Leiden. Mr. Schilt and Mr. Schlesinger also attended the meeting of the Astronomische Gesellschaft at Heidelberg.

An extension to the Observatory, authorized last year, was finished by the end of August. It adds six office rooms and a small lecture hall to the Observatory building.

Mr. Schilt completed with the Catalogue Camera the set of forty-eight plates (11° by 14°) necessary for the measurement of the zone from 20° to 30° declination. During the year 25 of these plates were measured under Miss Barney's supervision, making a total of 40 (out of 48) that had been measured. The twenty-five plates measured this year show the images of approximately 20,000 stars whose positions are to be determined. During the year 17 additional plates were reduced, bringing the total up to 42, or about eighty-five per cent of the total.

All the measurements and reductions in the zone 55° to 60° are now completed, and the resulting catalogue is being prepared for publication. This zone was carried out by means of fields about 5° square, the plates having been secured at Allegheny Observatory in 1916. As would be expected, the positions are of the same high degree of accuracy as was attained in the zones —2° to +2°, and +50° to +55°.

In the zones to be issued from this observatory hereafter, beginning with the one from 20° to 30°, it is our intention to measure and publish the photographic magnitudes in addition to the positions. Mr. Schilt is in charge of this portion of the work. During the year he secured 46 plates for this purpose, bringing the number up to 65. Of these about half are experimental, so that some 35 plates remain to be

secured. On these plates he has measured, by means of his thermo-electric photometer, the magnitudes of about 8,500 images. About 20 per cent of the total amount of measuring is therefore completed.

Miss Gesler has kept up to date the card catalogue of stellar parallaxes, which includes all reliable determinations of the distances of stars. She has also kept up to date a card catalogue of radial velocities. One of the objects of constructing the latter is in connection with a catalogue of bright stars, which has been compiled and kept up to date in manuscript form for a long period of years by Mr. Schlesinger, with the assistance of many people. A grant from the National Academy of Sciences will enable this catalogue to be published within the next few months. It contains all important known facts concerning 9,000 of the brightest stars, in both the northern and southern hemispheres.

Mr. Brown has been engaged this year on the occultation work and the theory of the eighth satellite of Jupiter. Owing to the large number of observations of occultations sent in by professional and amateur astronomers, the work of discussing the results was much greater than in previous years. With the help of his assistant, Mr. Brouwer, this work was carried through successfully, without undue delay, and the results were published in a series of papers in the *Astronomical Journal*. During the latter part of the year Mr. Brown and Mr. Brouwer were occupied in finishing the first stage of the theory of the eighth satellite of Jupiter, a piece of work which Mr. Brown had had on hand for several years. This work is now being prepared for publication. Some time was also spent on a discussion of the theory of the minor planet Vesta, at the request of the Astronomer Royal of England.

Mr. Schilt has continued his investigation on Cepheid variables. He finds that these stars form at least two groups, according as the periods are less or greater than about ten days. Statistical considerations show that the former (typical Cepheids) are very closely related to the *c*-stars, i.e. those having very sharp lines in their spectra. Their absolute magnitudes are very high, and they show a remarkable distribution in space, the most luminous appearing to be in general at small distances from the center of our stellar system. Cepheids having periods greater than ten days do not show these characteristics. They are not so bright and their distribution is more general. Mr. Schilt has also continued his work on systematic motions of stars. Investigation into the nature of the terms in the motions of the stars that go through their cycle twice in a circumference indicates that they cannot be interpreted as a result of a galactic rotation of the form suggested by Lindblad and Oort. He further finds that the stars, instead of having haphazard motions with a random preferential axis, belong to separate streams, and that the random portion of the motions is less pronounced than hitherto supposed.

Six additional metal plateholders have been made at the Observatory shops in New Haven and sent to Johannesburg. Eighteen of these plateholders are now available, a number sufficiently large to obviate

the necessity for reloading the plates during the intervals of two hours or so in which parallax observations are made at the beginning and the end of the night. A coarse objective-grating has also been made and sent to Johannesburg. The elements are made of taut linen fishline, and they cover the whole objective. This grating produces first-order spectra about 4.5 magnitudes fainter than the central image, and is intended, among other purposes, for the determination of the parallaxes of very bright stars.

Dr. Alden reports that during the year ending April 30, 1929, 174 nights were clear, 123 were partly cloudy, and 68 were cloudy. The telescope was in use on 238 nights, a number that would have been somewhat increased if more than two observers had been available. During this period 4,846 plates were added to the files, bringing the total up to about 16,400. In addition to the above, the telescope has been used by Mr. van Gent of the Leiden Observatory for securing plates in the Magellanic Clouds for photometric purposes. Most of the 4,846 plates were secured for determinations of stellar parallax; ninety-nine plates are of Selected Areas, completing all the regular and special regions south of the equator, with the exception of the single one at the south pole; twenty-two plates complete the program relating to the proper motions of variable stars of the RR Lyrae type; finally, there are fifty-eight plates of the satellites of Saturn and twenty-five plates of the satellites of Jupiter.

Up to April 30, 1929, 106 parallaxes have been derived at the Southern Station. The 1928 and the 1929 plates of Jupiter's satellites have been measured, and the results published, at Dr. de Sitter's suggestion, in the *Bulletin* of the Astronomical Institutes of the Netherlands in papers that contain a reduction of these measures by members of the Leiden staff. The plates of Pons-Winnecke comet, secured in 1927, were also measured and reduced this year. A beginning has been made on the measurements of the 1927 plates of the satellites of Saturn. A special study has been made on the irregular proper motions of Delta Aquilae, and a few double stars have been measured on the parallax plates.

FRANK SCHLESINGER, *Director.*

YERKES OBSERVATORY

UNIVERSITY OF CHICAGO

WILLIAMS BAY, WISCONSIN

Personnel. Professor Georg Struve of the Observatory of the University of Berlin at Neubabelsberg, was visiting professor during the summer and used the 40-inch telescope for micrometric observations of the satellites of Saturn and Uranus.

Mr. Van Biesbroeck returned on September 3 from his vacation trip to Europe, where he attended the meeting of the International Astronomical Union at Leiden.

Mr. Ross spent August and September at the Mt. Wilson Observatory and for the academic year beginning October 1, 1928, served on a half time basis, working on optical problems connected with the proposed 200-inch reflector of the California Institute of Technology, but conducting this research at the Yerkes Observatory.

Under a Guggenheim traveling fellowship, Mr. Otto Struve was absent on leave from the Observatory from August, 1928, through May, 1929, and spent most of his time in work with Professor Eddington at Cambridge.

Mr. C. T. Elvey rejoined the staff on August 1 and worked especially with the Bruce spectrograph and in the study of contours of stellar lines with the registering photometer.

On September 1, 1928, Mr. Arthur S. Fairley began a research on the photographic magnitudes of the brighter stars, in continuation, southward, of the late Professor Parkhurst's Yerkes Actinometry, and with the use of extra-focal images secured with the Zeiss UV doublet.

Equipment. Photo-electric photometer. Under a grant from the Rosenwald Fund the construction of a photo-electric photometer was begun early in 1929 in the shops of the University of Wisconsin, at Madison, under the personal supervision of Professor Joel Stebbins. The adaptation of this photometer to the 40-inch telescope was made in June and Mr. Stebbins came to the Observatory at the end of June as visiting professor for the summer quarter of 1929. Mr. C. T. Elvey collaborated in this work. In order to facilitate the changing of auxiliary apparatus, such as the photo-electric photometer, the camera for stellar parallax, the direct solar plateholder, and the micrometer, a new system of attachment was carefully worked out by Mr. Moffitt and the first adapter was completed in the shop. This was so planned as to fit the tail-pieces of the new 12-inch telescope, whereby the photometer may be attached, if desired, to the 12-inch, or the solar spectrograph or other equipment of the 12-inch may be transferred to the 40-inch telescope.

Work was begun on an entirely new stellar parallax camera, according to designs worked out by Mr. Moffitt.

The new mounting for the 12-inch telescope was received after an absence for about a year, from J. W. Fecker on June 18, 1928. The old pier, driving clock, and polar axis were retained. The twin tubes were made of duralumin and their weight was not much changed from that of the original single steel tube. The polar axis was bored out to carry an electrical cable. New and identical tail-pieces were supplied by Fecker. A new cradle for carrying the solar spectrograph was also made by Fecker. Many important items, such as the system of counterweights and the provision of diaphragms, shutters, and electric attachments were not included in the contract with Mr. Fecker, but were done here by Mr. Ridell with the coöperation of Mr. Moffitt, who had greatly assisted the director in all the plans for the reconstruction of this instrument. A new double slide plateholder was also made in our

shop by Mr. Ridell, which could be guided by illuminated cross wires in the axis of the visual telescope.

A Hale spectrohelioscope, received in February, 1928, was, after some preliminary experimentation at the window of the spectroscopic laboratory, set up in the tower of the southeast dome, under the 24-inch reflector. The coelostat is mounted on a track supported by the railing of the outer balcony and the apparatus was installed horizontally. Since there was no suitable place in the Observatory for obtaining the horizontal length of 35 feet or more needed, a special lens was designed by Mr. Ross in place of the crossed lens of 18 feet focus usually supplied for this equipment. This lens consisted of two members separated by 48 inches and well corrected for spherical aberration and coma, and was made by Bausch and Lomb, and gave a two-inch image of the sun on the slit, at a distance of 6 feet from the front member. Mirrors of fused quartz of 6 and 5 inches diameter were made for the coelostat by the General Electric Company. This equipment worked very satisfactorily, particularly with the Anderson method of rotating prisms in front of the slits and constitutes a valuable auxiliary in our solar work.

Weather Conditions. These were not as favorable as in the preceding year and the total number of hours of nocturnal observations at the 40-inch telescope was 1354, which is nearly 150 hours below our normal. The months of summer and early autumn were the best with 188 hours for September. The least favorable month was January with only 79 hours, which is much lower than usual. During the diurnal hours 195 days were clear or fair while 170 days were partly or wholly cloudy.

Solar Work. With the Rumford spectroheliograph 676 exposures were made, of which 378 were of the disk and 298 of prominences. Observations were thus made on slightly more than 112 days, and almost entirely by Messrs. W. W. Morgan and C. D. Higgs. Special attention was given by Mr. Morgan to the solar disturbance of July 17, 1928. Direct photographs of the sun, through a yellow filter, were taken on 46 days with a total of 77 plates. After the 12-inch twin telescope could be used, beginning July 18, 1929, 120 plates were obtained on 68 days, chiefly by Messrs. Morgan and Fairley. Heliographic positions of the sunspots were measured on 30 days for completing the series published by the Naval Observatory in the *Monthly Weather Review*.

Observations with the 40-inch telescope. Micrometric. Mr. Van Biesbroeck made measures of 337 close double stars and observed comets for position, brightness and appearance, as follows: 8 for Comet 1927 *d* (Stearns) and 10 for comet 1929 *a* (Schwassmann-Wachmann). On nights of poor seeing, 80 estimations of faint variable stars of Mr. Ross' list were secured. Mr. Georg Struve observed the positions of the satellites of Saturn on parts of 23 nights and obtained a very few positions of the satellites of Uranus. He also included in his program a small list of double stars.

Astrometric. In continuation of the program of determining stellar

parallaxes by the trigonometric method, 615 exposures were made. Of the 462 regarded by Mr. Moffitt as fully usable, 277 were taken by himself, 85 by R. S. Zug, 70 by A. S. Fairley, and 30 by W. W. Morgan. The observational material for 14 stars was completed during the year and 226 plates were measured by Mr. Moffitt. Twenty-seven new stars were added to the program and their fields examined by him and at least one usable plate secured.

Spectrographic. The Bruce spectrograph was used on 112 nights and 576 spectrograms were obtained. For 237 of them a dispersion of 3 prisms was employed, for 18, two prisms; and for 321, one prism. The observers and the number of plates secured by them, with the regular assistance of Mr. Sullivan, were as follows: Elvey, 205; Barrett, 182; Pogo, 141; O. Struve, 35; Hujer, 11, and Zug, 2. In July Mr. Struve made experiments with the new correcting lens and found that it gave a considerable increase in speed when the seeing was good. Direct photographs of double stars, taken with the new correcting lens, show its excellent optical qualities in the central field. A new sensitometer had been constructed in our shop by Mr. Ridell, similar to that previously employed by Mr. Ross, whereby a series of 14 disks may be impressed upon the plate with definite ratios of intensity. After June 24, 1928, all spectrograms were first exposed in the new sensitometer, so that they could be employed rigorously for photometric purposes.

Mr. Pogo studied several interesting spectroscopic binaries and, in the absence of Mr. Struve, gave special attention to the star 27 Canis Majoris, in the large mass of which Mr. Struve is especially interested. The velocity of the star increased during the whole season, passing to positive values, so that the long period was confirmed.

Mr. Y. C. Chang, fellow, measured 63 spectrograms of visual binary stars and published orbits for two of these. His thesis was on the subject of the determination of the inclination of the orbits of binary stars and he received the Ph.D. degree in March, 1929.

Mr. C. Hujer, graduate student, continued his studies on the silicon and strontium lines in stellar spectra and assisted in the observations at the Bruce spectrograph.

Mr. Elvey completed the determination of the contours of the helium lines, $\lambda 4388$ and $\lambda 4472$ for 28 stars, and worked on the contours of Mg+ and the hydrogen lines, $H\beta$ and $H\gamma$, in the spectra of 60 A and B stars. He also began the study of several stars of class F5 for comparison with those of Epsilon Aurigae, now passing through photometric minimum, which star has long received special attention at this observatory. Some of the metallic lines in the spectra were noted to be asymmetrically broadened towards the violet in October and November, 1928, but in December they had become symmetrical.

24-inch reflector. Mr. Van Biesbroeck was assisted by Mr. Chang in securing positions of faint asteroids needing observation. Three hundred seventy-two plates were obtained, of which the majority were

duplicate exposures for determining the positions of 142 asteroids. The remainder were taken by Mr. Van Biesbroeck for the positions of comets.

Mr. W. H. Garrett continued his observations of the color index of planetary nebulae during the summer, as conditions permitted.

Bruce Photographic Telescope. Mr. Ross continued his comparison, with the blink instrument, of his new plates with similar fields taken 15 to 20 years ago by Professor Barnard. His seventh list of proper-motion stars, covering numbers 788-828, and his eighth list of new variable stars, covering numbers 345-367, appeared in the *Astronomical Journal* during the year. He obtained photographs of 171 fields, each generally with three different cameras, the 10-inch and the 3-inch photographic and the 3-inch photovisual. The 3-inch photographic lens was stopped down to 40 mm in order to match the exposures with its photovisual twin. By blinking the plates thus secured, the red stars can be easily picked out. After October 1, 1928, Mr. R. S. Zug regularly assisted Mr. Ross in the work at the Bruce telescope. During July and August, 1928, Professor F. E. Carr of Oberlin, secured 16 plates with the 10-inch camera for the purpose of studying the magnitudes in the Kapteyn areas.

Zeiss Camera of U.-V. Glass. In the determination of some of the photographic magnitudes of stars brighter than magnitude 8, Mr. Fairley obtained on parts of 101 nights, 504 plates. Three hundred fourteen of these are extra-focal plates and 190 were focal plates taken with the yellow filter for finding color indices. All of the stars were in the zone from 65° to 75° north declination. The magnitudes of 706 stars were determined by measurements of 238 plates. On the average, a star appears on six plates.

General. The definitive orbit of comet 1925 VII (Van Biesbroeck) was completed by Mr. Van Biesbroeck, but the computation backward of the perturbations, in order to find the original form of the orbit, has not yet been concluded. Furthermore, several ephemerides were computed by Mr. Van Biesbroeck for the comet notes regularly supplied for publication in POPULAR ASTRONOMY. An orbit was computed for comet 1929 *a*, with the aid of Mr. Chang, and with the use of two positions on Bruce plates taken before the discovery of the comet.

Miss M. R. Calvert was occupied in preparing the tabular matter and diagrams for Mr. Barnard's micrometric observations of the star clusters, which are in press as part 1 of volume 6 in the *Publications* of the Observatory. She also extracted from Mr. Barnard's observing books many unpublished data regarding variable stars, and assisted the director in various ways.

Mr. Morgan made about 900 visual observations of variable stars, chiefly with the 12-inch telescope.

The accessions to the library numbered 243 bound books. A valuable addition was the complete file of 45 volumes of the *Zeitschrift für Physik*.

EDWIN B. FROST, *Director.*

PLANET NOTES FOR JULY AND AUGUST

By CLIFFORD E. SMITH.

The *Sun* will be moving southeast from the central part of Gemini, across Cancer, to the central part of Leo. On July 3, the earth will be at its greatest distance from the sun, that is, the earth will pass through its aphelion point. The position of the sun on July 1, August 1, and August 31, will be, respectively: R.A. $6^h\ 37^m$, Decl. $+23°\ 11'$; R.A. $8^h\ 42^m$, Decl. $+18°\ 16'$; R.A. $10^h\ 34^m$, Decl. $+9°\ 0'$.

The phases of the *Moon* will occur as follows:

First Quarter	July	2 at 10	P.M.	C.S.T.
Full Moon		10 " 2	P.M.	"
Last Quarter		18 " 5	P.M.	"
New Moon		25 " 3	P.M.	"
First Quarter	Aug.	1 " 6	A.M.	"
Full Moon		9 " 5	A.M.	"
Last Quarter		17 " 6	A.M.	"
New Moon		23 " 10	P.M.	"
First Quarter		30 " 6	P.M.	"

The moon will be at apogee on July 13 and August 9, and at perigee on July 26 and August 23.

Mercury will be moving with an apparent easterly motion from eastern Taurus, across Gemini, Cancer, and Leo to western Virgo. Its apparent brightness will vary from about magnitude —1 at the beginning of the period to about magnitude +1 at the end of the period. Mercury will be in conjunction with several objects during this period. On July 5, it will be in conjunction with Jupiter, on July 15, at superior conjunction with respect to the sun, on July 26, in conjunction with the moon, on August 5 in conjunction with Neptune, and on August 25 it will be in conjunction with the moon again. On August 26 Mercury will be at its greatest elongation east, thus at the end of this period Mercury will be an evening star and it will set about an hour and a half after the sun.

Venus will be moving apparently southeast from the western part of Leo to the eastern part of Virgo. It will be in conjunction with Neptune on July 16, and on July 28 and August 27 it will be in conjunction with the moon. During this period it will set about three hours after the sun, and its brightness will be of about magnitude —4.

Mars will be in Taurus, moving from the western to the eastern part of the constellation. On July 22 and on August 19 it will be in conjunction with the moon. During the middle of this period it will be on the meridian about 8:00 A.M. Civil Time, and its brightness will be of about the first magnitude.

Jupiter will be near the sun in apparent position, conjunction with the sun having occurred late in June.

Saturn will be in western Sagittarius, and its apparent motion will be retrograde. On July 9 and on August 6 it will be in conjunction with the moon, and on July 1 it will be in opposition with respect to the sun. During the early part of July it will be on the meridian about midnight, and it will be of magnitude about 0.3.

Uranus will be in the south central part of Pisces. Its apparent motion will

be easterly until July 21 after which it will be westerly. On July 8 it will be in quadrature west of the sun, and on July 18 and on August 14 it will be in conjunction with the moon. Early in July it will be on the meridian about 6:00 A.M. Civil Time.

Neptune will be near the sun in apparent position, conjunction with the sun occurring on August 27. On July 16 it will be in conjunction with Venus and on August 5 it will be in conjunction with Mercury.

Circular Orbit Elements of the Trans-Neptunian Planet X.

These circular elements and the ephemeris following are based upon two positions, one of January 23, 1930, and the other of March 30, 1930.

$\Omega = 109° 30' 8''$
$i = 14\ 56\ 23$
$a = 39.8683$ units
Log. $a = 1.6006277$
$\mu = 14''.096$
Period $= 251.7386$ years

1930 Jan. 23	1930 Mar. 30
$l = 108° 35' 55''$	$l = 108° 51' 24''$
$b = -0\ 14\ 28$	$b = -0\ 10\ 20$
Log. $\rho = 1.5900967$	Log. $\rho = 1.5988370$
$u = 359° 3' 53''$	$u = 359° 19' 55''$

Three computed positions of X based upon these circular elements are:

1930	α h m s	δ ° ′ ″	Log. Δ
October 20	7 31 5	+21 50 6	1.5995792
October 30	7 31 3	+21 50 46	1.5977281
November 9	7 30 50	+21 51 51	1.5959539

FRANK E. SEAGRAVE.

Boston, Massachusetts, May 13, 1930.

Occultations Visible at Washington

[From the *American Ephemeris.*]

Date 1930	Star	Mag.	IMMERSION Washington C.T. h m	IMMERSION a m	IMMERSION b m	IMMERSION Angle E from N °	EMERSION Washington C.T. h m	EMERSION a m	EMERSION b m	EMERSION Angle E from N °
July 3	*h* Vir	5.4	23 47	—0.5	—1.9	128	0 46	0.0	—1.5	282
7	24 G.Sco	6.2	1 12	—0.6	—0.7	66	2 10	—0.9	—2.3	310
11	40 B.Cap	6.2	20 42	—0.3	+0.5	124	21 37	—1.6	+2.4	220
17	10 Cet	6.4	1 29	—0.9	+2.2	44	2 46	—1.5	+1.6	240
17	77 Psc	6.4	22 41	+0.3	+1.6	63	23 38	0.0	+1.7	241
21	14 H¹.Tau	6.5	1 49	—0.8	+0.1	130	2 12	+1.2	+3.2	179
Aug. 6	234 B.Sgr	5.9	19 22	—1.5	+1.2	89	20 49	—2.0	+0.6	266
12	4 Cet	6.3	20 39	0.0	+1.7	74	21 40	—0.4	+2.0	230
12	5 Cet	6.3	20 56	—0.1	+1.8	65	22 0	—0.5	+1.9	237
13	155 B.Psc	6.5	21 17	+0.1	+2.0	42	22 15	—0.3	+1.5	258
17	63 Ari	5.2	3 37	+0.6	+4.2	1	4 19	—3.2	—0.9	295
17	65 Ari	6.0	4 15	—1.2	+2.3	43	5 34	—2.0	+0.7	254
31	43 Oph	5.4	22 19	—0.9	—0.9	76	23 28	—0.7	—1.6	279

The quantities in the columns a and b are given for the purpose of making these predictions useful for any place within 200 or 300 miles of Washington. The procedure is as follows: Subtract the longitude of Washington (77°.1) from the

longitude of the place in question; multiply the result, taking the signs into account, by the quantity under *a* for the star to be observed; similarly, with the latitude (38°9) using *b*; apply the sum of the products, with its proper sign, to the Washington C.T., and obtain the predicted Washington Civil Time for the phenomenon at the place of observation. To obtain Eastern Standard Time it is necessary to add 8.3 minutes to Washington Civil Time.

METEOR NOTES

By CHARLES P. OLIVIER.

It is a pleasure to turn from the relatively scanty records of our members, made during the first hundred days of the year, to those which have been arriving during the past month. The annual showers of the Lyrids and Eta Aquarids were largely responsible for this, though the better hourly rates to be expected and the warmer nights also had their effect. The detailed results will be seen in the following table. Already enough data are in to make the general statement that the two showers, just mentioned, returned in very poor numbers in 1930. Both, however, were certainly observed on several nights, and by a goodly number of persons who have already reported.

Our membership continues to grow, if slowly, and every now and then a new member starts a campaign showing that he understands what he is about and is really in earnest about making his results worth while. As an example, Mr. D. F. Waugh, of Tokio, Japan, has begun this year to send in numerous good reports. We are happy to have an active member in about the same latitude in which most of us live but in such a different longitude. Doubtless by his example, we have just received the résumé of observations of Mr. K. Komaki of Kanaya, Japan. These sets are valuable in checking the rates obtained on the same dates in America.

Our members ought to know of work done in other countries. The writer now receives regularly the publications of the great Russian Amateur Society "Mirovédénié," and also those from the meteor observers in Czechoslovakia, the latter published through Dr. V. Guth. In both countries not only is a great deal of fine observing done but several men of ability are studying meteors from the theoretical standpoint. The A.M.S. will have to work very hard in the future if we do not want to see other countries turning out far better results than we do. It is a pity that in many cases language difficulties make it impossible to study these articles, though the tabular results can of course be understood and used. Needless to say our friends of the Meteor Section of the B.A.A. continue their excellent work. Brief reports come out in "The Observatory" nearly every month, written by Mr. A. King, one of the best of meteor observers and a man who has done valuable theoretical work along these same lines. Prof. M. Dartayet of La Plata Observatory, Argentine Republic, has been instrumental in forming a meteor section of the "Amigos de la Astronomia" which has already begun to function. In fact never has there been so much sustained interest in meteoric astronomy as at present.

Reports of fireballs continue to arrive in good numbers. Not counting those sent in by A.M.S. members, noted during their regular periods of observations, already we have 45 up to May 4. Of greatest interest is a fine bolide seen from

this state to North Carolina, which the writer is following up. This appeared on May 3 at 8:44 E.S.T. Already we have one good observation from Pennsylvania, one from Maryland, and a number from Virginia, with others promised. Apparently the actual path of the object was wholly or at least mostly over Virginia. There is every hope that enough data will be gathered for a good solution.

As there will be no more issues of POPULAR ASTRONOMY until the August-September number, this opportunity is taken to urge upon all the necessity of full observations during the summer. We have a chance of seeing the meteors connected with Pons-Winnecke's Comet, which may appear during the last days of June. Then about July 27 to 31 the Delta Aquarids and in August the Perseids always appear. Yamamoto of Kyoto, Japan, has just cabled me that he expects a new shower connected with Comet 1930 *d* to be seen about June 9, the radiant being at $\alpha = 237°$, $\delta = +43°$.

For observers who live from 40 to 100 miles of one another we strongly advise duplicate observations at the time of the maximum of the Perseids. We hope to organize a rather ambitious program, with several observers coöperating, in this immediate neighborhood. However, our chances for clear weather are not too good in August. Those who have clear skies should by all means not neglect the best certain shower of the year.

The sequel to the writer's book "Meteors" entitled "Comets" is now in press and should appear by the end of the summer. Certain parts will deal with the connections between these two classes of bodies, and with theories of their origins.

An interesting observation is reported by Mr. C. B. Roe of Pittsburgh, Pa., for May 4, 2:17 P.M., E.S.T. While observing the Moon with a 2½-inch refractor, he saw a meteor, brilliant enough to show up bright against the crescent, pass across it to the north. It traveled quite slowly, and an immediate attempt to follow along the direction it was going, with the telescope, was unsuccessful. This added certainty, as he says, that it could not have been a bird.

It may call out the spirit of adventure among our members to tell them of a new peril in meteor work. Our good friend Mr. Sterling Bunch, though accompanied by Mrs. Bunch, was followed to his place of observation on a hill-top by four police, who had never heard of the activities of the A.M.S. It took fifteen minutes of hard work to convince the guardians of the law that our colleagues were not bent upon some dark plot against the peace of their earthly neighbors instead of being intent on plotting meteors in the skies.

Many radiants have been derived from the 1930 reports, but need further study before publication. We want no more useless and possibly fictitious radiants, based on slender evidence, to cumber our lists. Too many of such have been published by most of us in the past, including the writer. However, at present no reputable observer is known to follow the old custom of combining the work of from 10 to 60 days and calling his results(?) radiants. At least we are all now on safe ground in that respect, and only those of us who were working twenty years ago know what a great advance that is!

To new readers, who do not know our customs, a cordial invitation is extended to write for information about the work of the A.M.S., if they are interested therein.

BEN W. SMITH, ROANOKE, VIRGINIA.

1929	Began	Ended	Total	Meteors	F	Rate	Cor.Rate	Notes
Aug. 12	12:30	16:00	210	75	1.0	21.4	21.4	25 plotted

B. F. Darling, Lansing, Michigan.

1930	Began	Ended	Total	Meteors	F	Rate	Cor.Rate	Notes
Mar. 30	8:37	9:37	60	2	1.0	2.0	2.0	
April 1	8:35	10:06	70	2	0.9	1.7	1.9	
2	8:45	9:45	60	1	0.8	1.0	1.2	
3	9:00	10:00	60	2	0.8	2.0	2.5	
4	9:05	13:28	190	9	0.7	2.8	4.0	
14	8:55	9:55	60	2	0.4	2.0	5.0	Full Moon
18	12:15	13:35	80	4	0.6	3.0	5.0	(a)
19	9:33	13:25	105	7	0.5	4.0	8.0	(b)
21	12:00	14:35	155	30	0.8	11.6	14.5	(c)
22	11:52	12:52	120	11	0.7	5.5	7.9	6 Lyrids
May 2	15:10	16:20	70	4	1.0	3.4	3.4	3 Aquarids
3	9:51	10:51	60	1	1.0	1.0	1.0	
3	14:10	16:12	122	18	1.0	8.9	8.9	2 Aquarids

(a) Observed from window; 1 Lyrid. (b) Brilliant aurora; 3 Lyrids. (c) Possibly 40; Two of the meteors counted in the 30 appeared made up of clusters. If each separate body is counted, it would add 10 meteors to the night's total. Twelve possible Lyrids.

C. B. Ford, Ann Arbor, Michigan.

1930	Began	Ended	Total	Meteors	F	Rate	Cor.Rate	Notes
May 3	14:10	16:00	110	5	1.0	2.7	2.7	1 Aquarid

Robert Brown, Fort Worth, Texas.

1930	Began	Ended	Total	Meteors	F	Rate	Cor.Rate	Notes
April 19	10:06	13:43	217	19	0.8	5.2	6.5	

O. E. Monnig, Forth Worth, Texas.

1930	Began	Ended	Total	Meteors	F	Rate	Cor.Rate	Notes
April 19	10:06	13:43	217	15	0.8	4.1	5.1	4 Lyrids
21	11:17	13:10	113	18	0.8	9.6	12.0	10 Lyrids

Sterling Bunch, Knoxville, Tennessee.

1930	Began	Ended	Total	Meteors	F	Rate	Cor.Rate	Notes
April 19	9:43	11:16	93	7	1.0	4.5	4.5	
19	11:45	12:16	31	4	1.0	7.7	7.7	
19	9:43	11:16	93	10	1.0	6.5	6.5	(a)
21	9:40	11:35	100	13	0.9	7.8	8.7	
21	9:40	11:35	100	14	0.9	8.4	9.3	(a)

(a) Different meteors; count by Mrs. Bunch.

B. S. Whitney, Beaver, Oklahoma.

1930	Began	Ended	Total	Meteors	F	Rate	Cor.Rate	Notes
April 15	8:50	9:50	60	3	1.0	3.0	3.0	
18	12:25	14:25	120	27	1.0	13.5	13.5	3 certain Lyrids
20	14:30	16:00	90	25	1.0	16.7	16.7	1 certain Lyrid
May 3	14:15	16:35	140	31	1.0	13.4	13.4	4 Aquarids

C. P. Olivier, Flower Observatory, Pennsylvania.

1930	Began	Ended	Total	Meteors	F	Rate	Cor.Rate	Notes
May 2	14:56	15:56	60	6	0.8	6.0	7.5	3 Aquarids

W. P. Warner, Flower Observatory, Pennsylvania.

1930	Began	Ended	Total	Meteors	F	Rate	Cor.Rate	Notes
April 22	12:30	14:40	130	2	1.0	1.0	1.0	1 Lyrid

F. W. Smith, Glenolden, Pennsylvania.

1930	Began	Ended	Total	Meteors	F	Rate	Cor.Rate	Notes
Mar. 23	8:15	9:15	60	0	1.0	0.0	0.0	
26	8:45	9:20	35	1	0.9	1.7	1.9	
31	8:15	9:15	60	0	0.9	0.0	0.0	
April 2	8:55	9:55	60	2	0.9	2.0	2.2	
4	8:25	9:25	60	1	0.6	1.0	1.7	
20	9:00	10:20	80	1	0.9	0.8	0.9	
22	8:30	9:30	60	0	0.9	0.0	0.0	
May 3	13:30	15:30	120	9	1.0	4.5	4.5	5 Aquarids

D. F. Waugh, Tokyo, Japan.

1930	Began	Ended	Total	Meteors	F	Rate	Cor.Rate	Notes
April 3	11:30	12:30	60	2	0.9	2.0	2.2	
16	8:40	9:50	70	1	0.7	0.9	1.3	
18	9:39	11:49	130	4	0.7	1.8	2.6	
21	11:15	13:45	150	18	1.0	7.2	7.2	10 Lyrids
22	10:59	12:39	100	8	0.9	4.8	5.3	3 possible Lyrids

K. Komaki, Kanaga, Japan.*

1930	Began	Ended	Total	Meteors	F	Rate	Cor.Rate	Notes
Jan. 3	15:30	16:50	50	16	0.7	19.3	24.7	15 Quadrantids
Feb. 28	9:15	10:00	45	2	1.0	2.7	2.7	
Mar. 10	16:15	17:15	60	7	0.9	7.0	7.8	
21	9:05	10:05	60	4	1.0	4.0	4.0	
22	9:15	10:15	60	5	1.0	5.0	5.0	
26	13:40	14:30	50	1	1.0	1.2	1.2	
April 6	14:53	15:33	40	3	1.0	4.5	4.5	
21	10:50	12:25	75	13	1.0	10.4	10.4	
27	9:41	10:41	60	4	0.8	4.0	5.0	

J. L. Muñoz, Lomas de Zamora, Argentine Republic.

1930	Began	Ended	Total	Meteors	F	Rate	Cor.Rate
Feb. 23	8:05	9:50	84	3	1.0	2.1	2.1
25	10:00	12:01	121	15	1.0	7.4	7.4
28	10:00	11:19	79	9	0.7	6.8	9.7
Mar. 1	8:07	10:28	95	26	1.0	16.5	16.5
4	9:56	11:16	80	18	1.0	13.5	13.5
7	10:00	11:12	72	6	1.0	5.0	5.0

*Only a résumé (as published) was sent; not the originals. The accompanying radiants will be published later.

Flower Observatory of the University of Pennsylvania,
Upper Darby, Pennsylvania, 1930 May 24.

Recent Meteoric Falls.

The excellent *Catalogue of Meteorites of North America to January 1, 1909*, by Oliver C. Farrington is so complete that it is rarely necessary for a person to search outside of that catalogue for a meteorite recovered previous to that date. A more recent list of meteorites, but including only those whose fall has been observed, appears as Appendix II to the *Story of Meteorites* by George P. Merrill. This list includes falls of 1926. Since that date, so far as is known to us, only two falls have been reported in North America, the one at Tilden, Illinois, in 1927, and the recent fall near Paragould, Arkansas. Both of these falls were investigated by the University of Iowa. The complete list of North American falls, beginning with 1909, follows:

(1). Baldwyn, Mississippi, February 2, 1922. Stone.
(2). Blanket, Texas, May 30, 1909. Stone.
(3). Colby, Wisconsin, July 4, 1917. Stone.
(4). Cumberland Falls, Kentucky, April 9, 1919. Stone.
(5). Forksville, Virginia, July 16, 1924. Stone.
(6). Holbrook, Arizona, July 19, 1912. Stone.
(7). Johnstown, Colorado, July 6, 1924. Stone.
(8). Kilbourn, Wisconsin, June 16, 1911. Stone.
(9). Palahatchie, Mississippi, October 17, 1910. Stone.
(10). Paragould, Arkansas, February 17, 1930. Stone.
(11). Pitts, Georgia, April 20, 1921. Iron.
(12). Richardton, North Dakota, June 30, 1918. Stone.
(13). Rose City, Michigan, October 17, 1921. Stone.

(14). SHARPS, Virginia, April 1, 1921. Stone.
(15). TILDEN, Illinois, July 13, 1927. Stone.
(16). TROUP, Texas, April 26, 1917. Stone.

This list is only preliminary, and information on any additional falls will be appreciated.

C. C. WYLIE.

State University of Iowa, May 20, 1930.

NOTES FROM AMATEURS

Observations of Mercury.

The unusually favorable position of Mercury during the past two weeks has permitted some rather interesting observations with the naked eye and with a 6-inch reflector.

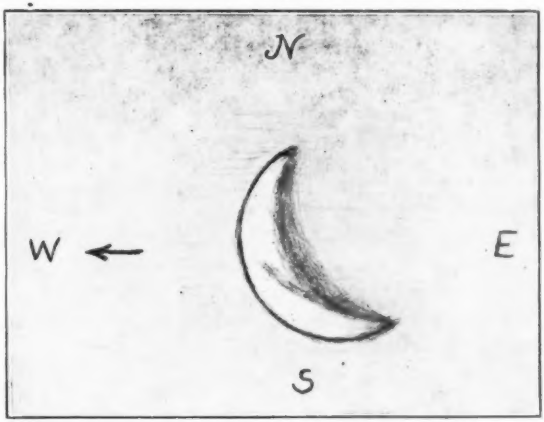
On the evening of April 19, at about 7:30 P.M., Mercury and Venus were seen from a street car window, which, as is usually the case, was none too clean. April 19 was eight days before maximum eastern elongation, yet the planet was so bright as to strike the eye at once, although the sky was far from dark. Three days later, April 22, from 7:30 till 8:00 P.M., Mercury was observed in a remarkably clear sky where stars could be seen close to the horizon. This gave a good opportunity to compare the naked-eye brightness of the planet with that of the neighboring stars. Three observers agreed that Mercury was decidedly inferior to Aldebaran, the latter, of course, being at a greater altitude. The planet was certainly brighter than β Tauri (1.8 mag.) and almost equal to γ Orionis (1.7 mag.). Mercury twinkled more than Venus, although the latter was nearer the horizon. In spite of the fact that the stellar magnitude of Mercury on April 21 is given as —0.3, it seems certain that, as viewed here in Washington in a clear sky, its brightness did not exceed 1.6 or possibly 1.5.

On April 20, 22, 23, 25, 26, 27, and 29, and on May 3, Mercury was observed with the 6-inch reflector, using powers of 75, 125, and 250 X. Observations were made for the most part between about five and six P.M., and on two occasions later in the evening. In other words, most of these views of the planet were in bright sunlight. Under these conditions, even on April 20, one week before elongation, when the planet should have presented the gibbous phase, the disk scarcely appeared dichotomized, but rather as a thick crescent. The terminator, however, was poorly defined and could not be said to occupy any definite position, as on the dark side the disk seemed to fade into the bright background of the sky. The bright edge, on the other hand, was extremely sharp.

On April 22 the width of the illuminated portion of the disk was practically the same as on the twentieth, but the southern portion, or what looked like the south horn of the crescent seemed rounded and faded out, as did the terminator. This appearance was not noticed the next day, April 23.

The terminator appeared quite clear and both horns sharp on April 25, though a width of not more than one-third the disk was visible in daylight.

On April 26 the accompanying sketch was made at about six P.M. There seemed to be a dark streak extending from the southern portion of the disk up towards the center on the bright limb. This was hard to see, but it *could* be seen by shading one's eyes. It had not been noticed before and was not seen again.



MERCURY, APRIL 26, 1930, AT 6:00 P.M.,
as seen with a Reflector.

The observation on April 27 was unsatisfactory as the air was bad, and all that could be said was that the disk presented the form of a rather narrow crescent. The planet had the same appearance before sunset on April 29, but when observed in a darkening sky at 7:45 P.M., the width of the illuminated disk was greatly increased, being fully 40 per cent of the whole. The terminator was still rather poorly defined, but the planet was at a low altitude.

On May 3 the observation was made at about 7:45 P.M. and the illuminated disk was much narrower, and probably corresponded closely with that predicted from calculation.

On several occasions Mercury was compared with Venus, the comparisons all being made in daylight. Venus being only slightly gibbous it was hard to make a true comparison of the appearance of the two terminators, but certainly there was nothing like the fading away of the illuminated disk as heretofore described, to be seen on Venus. In color and general appearance the old likening of Venus to burnished silver and Mercury to lead or pewter or a dull piece of aluminum seemed to hold.

The frequent references to the deficiency in the width of the illuminated disk of Mercury seem to be borne out, though when using a small instrument it is evident that much depends upon the time of day when the planet is observed. It seems likely that there are markings on the disk sufficiently pronounced for traces of them to be seen in a 6-inch telescope under conditions of reasonably good "seeing."

HUGH G. BOUTELL.

3723 Jocelyn St., Washington, D. C.

Auroral Display Observed. — On the night of May 3, 1930, Mr. B. C. Darling and myself witnessed an auroral display. Mr. Darling and I were combining in an attempt on the Eta Aquarid meteors, and were located some three miles east of Ann Arbor. He has asked me to send in a joint report of our observations, which follows:

"A broad green auroral band was first noticed by B. C. Darling at 9:51

E.S.T. As a watch for meteors was being made, no very close watch was given to the phenomenon, but it is a fairly safe assumption that the unfurling, wavering bands did not begin to develop before midnight. About midnight several prominent wavering flashes were noticed, but due to the press of meteors and variable star work no further notes were taken until about 13:20. From then until 14:10 at least four prominent green bands were noticed, and just below 10 Camelopardalis there was noticed a very black development of the "Dark Aurora." At 14:03 a very narrow green band shot up through Camelopardalis, and lasted about one minute before finally fading out. The aurora proper existed until about 15:00, but there were no more vivid flashes of shimmering emerald."

Following is my own report, kept chronologically.

12:20. First noticed band extending from N.E. to N.W. No streamers.

13:20. Bright diffuse light extending under band, and about 40° on either side of N. Fluctuating rapidly.

13:54. Band much brighter. Streamers up to 15° above the horizon at nearly all points above the band. Band extending 10° above N. point.

13:55. Streamers becoming brighter in N.E. and N.W. Little change in direct N. Saw "dark aurora" extending from about 3° west of north point, to 10° west of north point. Evidence that the dark patch was not a cloud was shown by the fact that a star was visible through it.

13:57. Streamers gone. Band diminishing.

13:58. Streamers developing in N.E. by N.

14:00. Double band seen. Smaller band under former one, with end points on horizon 15° E. and W., respectively, of N. Both bands fainter.

14:01. Brilliant diffuse patches of light under the bands. No definite streamers.

14:03. Streamers active. One reached up to 20° above the horizon, and was green and very narrow. A few fainter ones in N.E. and N.W.

14:05. Black aurora seen even more prominent than at 13:55, and in practically the same position.

14:35. Very much diminished, only one band remaining and no streamers.

14:50. Band very slowly diminishing.

15:40. Band practically disappeared at the first peep of dawn.

CLINTON B. FORD.

904 Forest Avenue, Ann Arbor, Michigan, May 8, 1930.

Brilliant Auroral Display.—I wish to give a record of a brilliant auroral display which I recently witnessed. It was on April 19, 1930, between 12:00 and 1:00 A.M., E.S.T. When I first noticed the light, about 12:20, it was in the form of a rather faint arch extending from the horizon at NE by N up to within about ten degrees of the pole star, and then cutting down in a similar arc to the horizon at NW by N. At about 12:25 some brilliant streamers came into view a bit to the east of the north point, and were soon followed by many more within the next few minutes. Finally the streamers extended from all of the horizon under the arch, and up to a few degrees beyond the pole star. This was at 12:35, after which the light rapidly diminished, until the arc was scarcely visible at 12:48. Then, at 12:51, I again noticed the light, but this time it increased very much more rapidly in brilliance, and the arch extended from a point which was almost due west, up at a slight angle from the horizon, crossing the

meridian not more than ten degrees north of the zenith, and likewise down to the eastern horizon. Streamers began again at 12:55, and became so brilliant that I was forced to discontinue working on variable stars in the north. There were little color differences in the streamers, nearly all of them being white or light red. They extended in some cases to a few degrees beyond the zenith, and were very variant in their form. At 1:00 the streamers from directly north had diminished considerably, and very bright ones began to manifest themselves in the NW and soon afterward in the NE. These did not extend more than twenty degrees above the horizon, but were brighter than the ones which earlier had reached the zenith. These began to diminish very rapidly at 1:10 and were gone by 1:15. The arch remained until 1:25, very slowly diminishing in brightness. At 1:30 no trace of the display could be seen.

CLINTON B. FORD.

904 Forest Avenue, Ann Arbor, Michigan, April 29, 1930.

Fireball Observed in California.—On May 13 at 12:25 A.M., P.S.T., an explosion occurred in the eastern sky. It was *very* bright. I was looking down at the time and could see much detail from the flash. Turning to the source of the light, the area of explosion was visible as a circular area about three moons in diameter. This quickly faded and left a streak, an area about half the diameter of moon in width and about six moons long—which remained visible in the moonlit sky for nearly three minutes. The surprising thing to me was the fact that the display remained stationary.

H. PAGE BAILEY, D.D.S.

Riverside, California, May 14, 1930.

VARIABLE STARS

Monthly Report of the American Association of Variable Star Observers for April, 1930.

Beloit College is represented herewith by Messrs. Huffer, Uplinger, and Ray, under "BE." Miss Leslie sends in a contribution from Vassar College made under the direction of Dr. Hawes. Nearly 400 variables are listed with practically 2400 observations as made by 40 different observers. One hundred far southern variables have been under observation by our southern hemisphere contributors, they having made more than a fourth of those reported.

Variable Comments, Vol. II, No. 4, has recently been distributed to members. Attention is again called to the opportunity for members to obtain a bound copy of Volume I, with or without their names printed on the cover. This is a splendid chance to secure a complete volume of this exclusive medium of contact between A.A.V.S.O. members at a very moderate cost. Communicate at once with the Recording Secretary, if a copy is desired.

The Association is the recipient of the 4-inch telescope outfit formerly used by our late member, Mr. Arthur C. Perry. This gift is made possible through the generosity and interest of Mr. A. C. Perry, Jr., who writes that he is pleased to thus carry out the wish so frequently expressed by his father that the A.A.V.S.O. should ultimately possess this instrument, so often used in the pioneer days of amateur variable star observing.

VARIABLE STAR OBSERVATIONS RECEIVED DURING APRIL, 1930.

Feb. 0 = J.D. 2426008; Mar. 0 = J.D. 2426036; Apr. 0 = J.D. 2426067.

J.D. Est. Obs.	J.D. Est. Obs.	J.D. Est. Obs.	J.D. Est. Obs.	J.D. Est. Obs.	J.D. Est. Obs.
V SCL	T SCL	W CAS	R PSC	Z CEP	R TRI
000339	*002438a*	004958	012502	021281	023133
033[13.3 Bl	053 10.5 Dr	056 10.0 Ah	030 11.1 Nz	055 14.0 Pt	972 6.5 Kd
S SCL	T PHE	064 9.7 Jo	035 11.7 Nz	o CET	976 6.9 Kd
001032	*002546*	067 10.2 BL	RU AND	*021403*	977 6.6 Kd
969 8.8 Kd	029[13.0 En	072 9.4 Jo	013238	010 9.2 En	977 6.5 Kd
012 10.8 Bl	036[13.0 En	U TUC	038 13.0 Ch	029 9.1 En	994 6.5 Kd
023 10.8 Bl	061[13.0 Bl	*005475*	039 13.4 L	036 9.0 En	001 6.5 Kd
026 11.3 Sm	W SCL	026[12.9 Ht	055 13.0 Pt	038 9.2 Ch	001 6.7 Kd
033 11.6 Bl	*002833*	029[12.9 En	060 12.6 L	041 9.1 L	011 6.8 Kd
X AND	033 13.1 Bl	034[12.9 Sm	Y AND	055 8.5 Pt	038 8.2 Ch
001046	Y CEP	034[12.9 Ht	013338	056 9.0 L	042 8.5 Tf
019[13.1 Nz	003179	034 14.0 Bl	038 11.3 Ch	S PER	045 8.5 Ah
023[13.5 Nz	056[14.1 L	036[12.9 En	039 11.5 L	021558	051 9.2 Sf
T CET	U CAS	063 13.8 Dr	053 10.3 L	054 9.4 B	052 8.8 Jo
001620	004047	057 13.9 Dr	055 9.8 Pt	055 9.2 BL	054 9.1 B
951 6.4 Kd	039 10.0 Ch	Z CET	065 8.8 L	055 9.0 Pt	055 8.8 Pt
969 6.1 Kd	042 9.7 L	*010102*	X CAS	056 9.3 Ah	056 9.2 Ah
976 6.1 Kd	051 9.7 Sf	032 12.3 L	014958	056 9.0 BL	056 9.5 Tf
977 6.2 Kd	053 9.1 L	U SCL	054 11.7 Bn	059 8.7 Jo	056 9.0 Jo
994 6.2 Kd	055 8.9 Pt	*010630*	055 11.5 Pt	065 8.8 Jo	056 9.4 Sf
996 6.0 Kd	056 9.0 Sf	034[13.2 Bl	060 11.5 Bn	067 9.5 BL	059 9.0 Jo
997 6.0 Kd	064 8.7 Sf	053 10.5 Bl	065 11.5 Bn	070 9.3 Jo	062 9.5 Tf
998 6.0 Kd	065 8.4 L	053 10.7 Dr	U PER	074 9.0 BL	064 9.5 Sf
011 6.0 Kd	RW AND	061 9.9 Bl	015254	R CET	W PER
014 5.9 Kd	004132	U AND	039 8.4 Ch	*022000*	024356
T AND	039[12.5 Ch	010940	045 8.2 Ah	038 8.7 Ch	039 10.4 Ch
001726	V AND	039 10.6 L	049 8.2 Ah	039 8.5 L	050 10.7 Sc
038 11.8 Ch	004435	053 10.9 L	055 8.4 Pt	051 9.0 L	050 10.7 Cv
055 11.5 Pt	019 9.6 Nz	S CAS	056 8.5 Ah	RR PER	054 10.3 B
T CAS	023 9.6 Nz	011272	057 8.5 Ah	022150	055 10.2 Pt
001755	030 9.9 Nz	055 9.5 Pt	062 8.6 Ah	039[13.4 Ch	056 10.6 Ah
038 11.2 Ch	039 10.7 Ch	056 9.9 Jo	XX PER	052 14.2 L	056 10.5 Jo
042 11.5 L	X SCL	059 9.6 Jo	015654	R FOR	059 10.5 Jo
052 11.5 Jo	*004435*	063 9.5 Jo	039 8.3 Ch	*022426*	064 10.3 Jo
055 12.0 Pt	012 11.0 Bl	069 9.0 Jo	R ARI	012 8.6 Bl	070 10.0 Jo
056 12.0 Jo	023 11.3 Bl	U PSC	021024	023 8.6 Bl	R HOR
062 12.0 L	033 11.5 Bl	011712	038 10.9 Ch	034 8.3 Bl	*025050*
R AND	053 11.7 Bl	039 11.8 L	039 10.8 L	044 8.5 Bl	012 9.6 En
001838	061[12.1 Bl	057 11.4 L	050 11.4 L	053 8.6 Bl	012 9.2 Bl
038 10.3 Ch	RR AND	R SCL	055 12.2 Pt	061 8.6 Bl	023 7.6 Bl
055 11.2 Pt	004533	*012233a*	063 12.4 L	U CET	026 7.4 Ht
S TUC	019 9.0 Nz	969 7.7 Kd	W AND	*022813*	029 7.1 En
001862	023 9.1 Nz	976 7.7 Kd	021143a	952 7.9 Kd	034 7.1 Sm
012 10.1 Bl	030 8.5 Nz	997 7.5 Kd	038 11.9 Ch	968 7.9 Kd	034 6.4 Ht
023 10.4 Bl	039 8.4 Ch	001 7.4 Kd	055 9.2 Pt	976 7.9 Kd	034 6.8 Bl
026 10.4 Ht	RV CAS	011 7.1 Kd	T PER	994 8.2 Kd	036 6.3 En
029 10.2 En	004746a	014 6.7 Kd	021258	998 8.4 Kd	044 5.7 Bl
033 10.1 Bl	039 9.5 Ch	053 5.8 Dr	055 8.8 BL	RR CEP	053 5.7 Bl
034 10.2 Sm	055 9.7 Pt	RZ PER	055 8.5 Pt	022980	053 5.8 Dr
034 10.4 Ht	— CAS	012350	056 8.7 Ah	052 13.3 Br	061 5.8 Bl
036 10.2 En	004746b	039 11.1 Ch	056 8.6 BL	055 13.4 Pt	063 5.9 Dr
044 10.5 Bl	055 11.0 Pt	039 10.3 L	059 9.2 Jo	056 13.3 L	T HOR
053 10.6 Dr	W CAS	056 10.9 L	065 9.0 Jo	R TRI	*025751*
053 10.6 Bl	004958	R PSC	067 8.9 BL	023133	012 12.6 Bl
063 10.8 Bl	039 9.6 Ch	012502	070 8.3 Jo	967 6.7 Kd	023 12.6 Bl
063 10.9 Dr	052 9.5 Jo	012 9.9 Nz	074 9.0 BL	968 6.8 Kd	026 12.7 Ht
	055 9.4 Pt	020 10.6 Nz		969 6.9 Kd	029 12.4 En
	056 9.7 Jo	023 11.2 Nz		971 6.7 Kd	034 12.7 Sm

VARIABLE STAR OBSERVATIONS RECEIVED DURING APRIL, 1930.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
T HOR	T ERI	R RET	R ORI	S PIC	S AUR
025751	*035124*	*043263*	045307	*050848*	052034
034 12.2 Ht	053 12.0 Dr	053 11.1 Bl	038 11.4 Ch	024 10.8 Bl	061 10.0 Ah
034 12.0 Bl	063 12.1 Dr	053 11.3 Dr	041 11.4 L	029 11.4 En	062 9.7 B
036 12.0 En	W ERI	060 10.6 Dr	062 11.6 L	029 10.8 Ht	063 9.8 BL
044 11.5 Bl	*040725*	061 10.3 Bl	062 11.8 B	034 11.4 Sm	067 10.1 BL
043 11.0 Bl	011 8.5 Dr	063 10.2 Dr	R LEP	034 11.2 Ht	072 10.2 BL
053 10.9 Dr	053 9.9 Dr	X CAM	*045514*	034 11.2 Ht	074 10.3 BL
061 10.5 Bl	063 10.2 Dr	043274	040 7.8 Ch	034 11.2 Bl	076 10.3 BL
063 10.5 Dr	R TAU	039 13.7 L	041 7.5 L	036 11.4 En	W AUR
U ARI	042209	040 13.0 Ch	042 7.5 Tf	044 11.3 Bl	052036
030514	011 12.8 Nz	053 13.7 L	043 6.8 Bc	053 11.8 Bl	053 14.6 L
012 14.9 Nz	023 13.1 Nz	054 13.9 Br	052 7.0 Jo	053 11.9 Dr	055 14.2 Pt
020[13.8 Nz	030 14.0 Nz	055 13.2 Pt	053 8.6 Tf	061 11.8 Bl	062[13.5 B
023 14.6 Nz	035 13.7 Nz	063 12.8 L	055 7.2 Pt	063 12.1 Dr	S ORI
030 14.7 Nz	048 14.0 Nz	067 12.1 B	056 7.6 L	R AUR	*052404*
035 14.6 Nz	054 13.9 B	R DOR	056 8.5 Tf	050953	038 10.3 Ch
038[13.1 Ch	055 13.8 Pt	*043562*	059 7.3 Jo	038 12.0 Ch	053 9.9 B
039 14.4 Nz	063 13.8 Nz	011 5.8 Dr	062 8.6 Tf	055 11.9 Pt	055 9.8 Pt
045 14.0 Nz	W TAU	012 6.2 Bl	064 8.9 Sb	057 9.8 Ah	T ORI
062 13.6 L	042215	024 6.3 Bl	064 7.7 Jo	069 10.9 B	*053005a*
063 13.4 Nz	039 10.8 Ch	026 5.5 Ht	066 7.8 Bc	T PIC	035 9.9 Ch
X CET	041 11.0 L	029 6.0 En	066 7.8 L	*051247*	038 10.1 Ch
031401	042 10.4 Tf	034 5.5 Ht	067 7.8 Jo	011 9.5 Dr	038 10.2 L
039 11.9 L	052 10.0 Jo	034 6.1 Bl	V ORI	012 9.5 Bl	039 10.9 L
051 11.5 L	053 11.0 B	036 5.9 En	050003	024 9.0 Bl	041 10.2 L
055 11.1 Pt	055 10.6 Pt	044 6.3 Bl	011 9.2 Nz	029 9.0 En	042 10.2 L
063 10.7 L	059 10.4 Jo	053 6.5 Bl	019 9.1 Nz	029 9.2 Ht	048 10.2 Pt
Y PER	062 10.9 L	053 5.8 Dr	023 9.5 Nz	034 9.0 Ht	050 10.0 Sc
032043	064 10.6 Jo	061 6.2 Bl	034 9.6 Nz	034 9.1 Bl	050 10.0 Cv
039 8.0 Ch	070 10.7 Jo	R CAE	038 9.8 Ch	036 9.1 En	050 10.3 Pt
049 8.4 Ah	S TAU	*043738*	041 10.0 L	044 9.4 Bl	050 10.1 L
055 8.2 BL	042309	012 11.9 Bl	048 10.3 Nz	053 9.0 Bl	051 9.6 Lg
055 8.0 Pt	011[14.3 Nz	029 12.0 En	051 10.2 Lg	053 9.3 Dr	052 10.2 L
056 8.7 Ah	023[14.8 Nz	034[12.0 Ht	055 10.4 Pt	060 9.3 Dr	053 10.2 L
056 8.3 BL	030 15.3 Nz	034 12.5 Bl	056 10.8 L	061 9.5 Bl	053 10.6 B
057 8.2 BL	048[14.3 Nz	044 13.0 Bl	056 10.0 Ah	063 9.2 Dr	054 10.2 Pt
067 8.5 BL	063[14.8 Nz	055[12.9 Dr	062 11.5 B	NOV TAU	055 10.3 Pt
072 8.4 BL	T CAM	062 13.7 Dr	063 11.2 Nz	051316	056 10.5 Jo
074 8.6 BL	043065	R PIC	067 11.3 Jo	056 14.2 L	056 10.2 L
R PER	040 13.2 Ch	*044349*	T LEP	T COL	057 9.9 Sc
033335	040 13.5 L	011 7.8 Dr	*050022*	*051533*	057 9.7 Pt
039 9.0 Ch	052 13.1 Br	012 7.9 Bl	011 8.8 Nz	012 12.2 Bl	059 10.0 Jo
042 9.2 L	055 12.9 Pt	013 8.2 En	012 8.5 Bl	024 12.5 Bl	062 10.1 L
054 10.0 B	062 12.4 L	024 8.5 Bl	019 8.7 Nz	029 12.1 En	063 9.7 Pt
055 9.5 Pt	RX TAU	029 8.4 En	023 9.1 Nz	029 12.3 Ht	064 9.6 Pt
062 10.7 L	043208	029 8.8 Ht	024 8.6 Bl	034 12.4 Ht	064 9.9 Jo
T FOR	055 14.3 Pt	034 9.0 Ht	029 8.1 En	034 12.5 Bl	065 10.2 L
032528	056 14.0 L	034 8.8 Sm	034 9.3 Nz	044 12.1 Bl	066 10.4 L
042 8.5 L	R RET	034 8.6 Bl	034 8.8 Bl	053 11.5 Bl	067 10.2 L
U ERI	*043263*	036 9.0 En	036 9.0 En	055 11.0 Dr	067 9.8 Pt
034625	010 12.7 Dr	044 8.9 Bl	044 9.0 Bl	060 10.8 Dr	067 10.0 Jo
029[12.3 En	012 12.4 Bl	053 8.8 Bl	048 9.6 Nz	061 10.6 Bl	068 9.7 Pt
036[13.0 En	023 11.9 Bl	053 8.4 Dr	053 9.4 Bl	S AUR	070 9.9 Pt
053 12.1 Dr	026 12.2 Ht	060 8.4 Dr	055 9.8 Pt	052034	071 9.9 Pt
063 11.8 Dr	029 11.8 En	061 8.7 Bl	061 9.9 Bl	038 9.2 Ch	074 10.4 Pt
T ERI	034 12.0 Ht	V TAU	063 9.8 Nz	055 8.7 Pt	075 10.5 Pt
035124	034 11.8 Bl	044617	S PIC	055 9.4 BL	077 10.4 Pt
029 10.6 En	036 11.6 En	038[13.0 Ch	*050848*	056 9.7 BL	
036 11.9 En	044 11.6 Bl	054 13.5 B	012 10.6 Bl	057 9.5 BL	

VARIABLE STAR OBSERVATIONS RECEIVED DURING APRIL, 1930.

J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs.

AN ORI
053005f
038 11.6 L
042 11.6 L
050 11.6 L
052 11.6 L
067 11.6 L

S CAM
053068
040 8.5 Ch
055 8.3 Pt
055 8.6 BL
056 8.6 BL
057 8.5 BL
063 8.8 BL
067 8.7 BL
072 8.8 BL
074 8.9 BL
076 8.9 BL
078 8.8 BL

RR TAU
053326
011 12.5 Nz
020 13.1 Nz
023 12.6 Nz
030 11.7 Nz
035 12.1 Nz
037 12.6 Nz
038 13.5 L
039 13.5 L
041 11.8 L
042 11.5 L
048 11.8 Nz
050 11.8 L
052 13.1 L
053 12.6 B
053 13.5 L
056 13.5 L
059 13.5 L
063 13.5 L
066 12.2 L
067 11.9 L
081 12.2 Ll

RU AUR
053337
038[12.8 Ch
055[12.5 Pt

U AUR
053531
038 9.3 Ch
041 9.3 L
049 9.3 Ah
055 9.8 Pt
056 9.8 Sf
061 10.0 Ah
062 9.8 Ah
062 9.3 L
062 9.7 B
064 10.0 Sf

SU TAU
054319
038 9.8 Ch
038 9.6 L
039 9.7 L
042 9.7 L
048 9.9 Pt
050 9.7 Pt
050 9.7 L
051 9.6 Br
052 9.7 Br
053 9.6 L
053 9.5 Br
054 9.7 Br
054 9.7 Pt
055 9.8 Pt
056 9.6 L
057 9.7 Pt
058 9.5 Ma
062 9.5 L
063 9.6 L
063 9.7 Pt
063 9.6 Br
064 9.6 Br
064 9.7 Pt
065 9.5 L
065 9.7 Br
066 9.6 Br
067 9.7 Br
067 9.6 L
067 9.7 Pt
067 9.5 B
068 9.6 Pt
068 9.6 Br
069 9.4 Ma
070 9.8 Pt
071 9.7 Pt
074 9.6 Pt
074 9.5 Br
075 9.6 Pt
076 9.6 Pt
077 9.8 Pt

S COL
054331
010 12.7 En
012 12.5 Bl
024 12.9 Bl
034 13.0 Bl
045 13.5 Bl
053[13.5 Bl
055[13.5 Dr
062 14.0 Dr

Z TAU
054615a
011 13.0 Nz
023 12.9 Nz
042 13.5 L
048 12.9 Nz
062 13.4 L
063 12.9 Nz

RV TAU
054615b
039 9.4 Ch
081 9.7 Ll

RU TAU
054615c
011 10.3 Nz
023 10.4 Nz
039 11.6 Ch
042 11.6 L
048 11.1 Nz
062 11.9 L
063 11.5 Nz

R COL
054629
010 11.4 En
012 11.8 Bl
024 11.9 Bl
029 12.7 Ht
034 13.0 Ht
034 12.7 Bl
036 12.6 En
045 12.9 Bl
053 13.3 Bl
055 13.2 Dr
061 13.6 Bl
062 13.2 Dr

α ORI
054907
039 0.3 L
053 0.3 L
063 0.3 L

U ORI
054920a
967 7.4 Kd
038 9.5 Ch
050 10.1 Sc
050 9.9 Cv
052 9.7 Jo
055 10.0 Pt
056 9.9 Wd
059 9.8 Al
059 10.0 Jo
062 9.4 B
064 10.7 Jo
069 10.2 Wd
070 11.5 Jo

V CAM
054974
055 14.6 Pt
056[14.2 L
066[13.9 Br

Z AUR
055353
048 10.0 Pt
050 10.0 Pt
051 9.5 Lg
054 10.2 B
054 10.1 Pt
055 10.5 Pt

Z AUR
055353
056 10.6 Ah
057 10.5 Pt
058 10.4 Pt
059 10.7 HS
059 10.2 Al
063 10.6 Pt
064 10.8 HS
064 10.2 Pt
066 10.4 Pt
067 10.2 Pt
068 10.3 Pt
070 10.4 Pt
071 10.8 HS
071 10.2 Pt
074 10.0 Pt
075 10.0 Pt
076 10.1 Pt
077 10.2 Pt

R OCT
055686
012[12.2 Bl
030[12.0 En
034[12.0 Ht
034 12.6 Bl
044 12.0 Bl
053 12.0 Bl
055 11.8 Dr
061 11.9 Bl

X AUR
060450
038 10.3 Ch
041 9.4 L
044 10.2 Lj
052 9.8 Lj
052 9.2 L
055 9.0 Pt
056 9.6 Sf
057 9.7 Lj
059 9.9 Al
062 9.3 B
063 9.6 Lj
063 9.1 L
066 9.7 Lj
067 9.2 Sf

V AUR
061647
040 10.9 Ch
051 10.1 Lg
054 10.0 B
056 10.7 L

V MON
061702
040[12.6 Ch
055 12.8 Pt

AG AUR
062047
052 9.3 L
063 9.1 L

U LYN
063159
051 12.1 Lg
062 13.0 B

R MON
063308
041 12.6 Ch
055 12.0 Pt
069 11.8 B

Nov PIC
063462
010 8.2 En
026 8.4 Ht
030 8.2 En
034 8.1 Ht
036 8.1 En

S LYN
063558
053 12.7 L
055 12.8 Pt
067 13.4 B

X GEM
064030
051 9.2 Lg
054 10.2 Bn
060 10.0 Bn
065 9.5 Bn
069 8.7 Bn
069 8.7 B

Y MON
065111
039 13.5 L
041 13.6 Ch
051 11.9 Lg
056 11.4 L
057 11.5 Sc
067 10.4 B
070 10.9 Sc
070 10.8 Cv

X MON
065208
039 9.2 L
042 9.7 Tf
052 9.1 L
053 9.9 Tf
056 9.3 Tf
062 9.5 Tf
063 8.7 L

R LYN
065355
051 13.5 Lg
053 13.1 L
067 13.2 B
075 12.4 BE

V CMI
070109
051[14.2 Br
056[14.5 L
067[13.5 Br

R GEM
070122a
049 8.9 Ah
052 9.4 Jo
055 8.9 Pt
056 9.8 Wd
056 9.6 Jo
057 9.5 Ah
057 9.9 Wd
059 9.9 Wd
059 9.3 Al
059 9.7 Jo
061 9.8 Ah
062 9.8 Ah
064 10.2 Jo
069 9.9 Wd
072 10.2 Wd
075 10.2 Wd
081 9.8 Al

Z GEM
070122b
055 12.4 Pt

TW GEM
070122c
055 7.7 Pt

R CMI
070310
039 10.9 L
056 10.5 Sf
062 9.4 L
064 10.5 Jo
067 10.5 Sf
069 9.6 B
070 10.1 Jo

R VOL
070772
013 11.6 En
026 11.1 Ht
030 11.8 En
034 11.0 Ht
036 11.8 En
053 10.7 Dr
063 11.0 Dr

L_a PUP
071044
009 5.1 Dr
011 5.1 Dr
053 4.9 Dr
057 4.9 Dr
060 4.8 Dr
063 4.8 Dr

RR MON
071201
056 9.8 Sf
064 9.5 Sf
070 9.1 HS
071 9.1 HS
071 9.3 Sf

VARIABLE STAR OBSERVATIONS RECEIVED DURING APRIL, 1930.

J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs.

V GEM
071713
051 14.0 Br
056 13.8 L
067 13.5 B
NOV MON
072106
062 14.5 Dr
S CMI
072708
055 11.8 BL
055 12.1 Pt
056 11.9 BL
057 12.1 BL
067 12.4 BL
T CMI
072811
056[14.2 L
069 13.8 B
Z PUP
072820b
019[12.1 Nz
023[13.7 Nz
037[13.7 Nz
048 13.7 Nz
S VOL
073173
011 12.0 Dr
012 12.0 Bl
024 11.5 Bl
026 11.4 Ht
030 11.4 En
034 10.7 Ht
034 11.0 Bl
036 11.6 En
045 10.8 Bl
053 10.8 Bl
053 10.6 Dr
060 10.8 Dr
061 10.9 Bl
U CMI
073508
039 12.6 L
062 13.0 L
S GEM
073723
052 11.6 Jo
055 11.0 Pt
056 11.3 Hs
065 12.0 Jo
069 11.9 B
070 11.8 Hs
W PUP
074241
011 10.0 Dr
012 10.0 Bl
013 10.3 En
024 9.4 Bl
026 9.4 Ht
030 8.5 En
034 8.6 Ht
034 8.1 Bl
034 8.5 Sm
036 8.2 En
045 7.8 Bl
053 8.9 Bl
053 8.2 Dr
057 8.6 Dr
060 9.0 Dr
061 8.9 Bl
063 9.0 Dr
T GEM
074323
052 10.2 Jo
055 9.0 Pt
057 9.0 Al
061 9.2 Ah
065 9.9 Jo
067 9.4 Jo
072 9.0 Jo
R CNC
081112
041 9.6 Bc
055 8.8 Bc
055 8.7 Pt
056 9.2 Ah
057 9.2 Ah
057 8.9 Wd
057 9.0 Fd
059 8.9 Wd
060 8.6 Ch
061 8.7 Ah
062 8.7 Ah
064 8.8 HS
069 8.5 Wd
071 8.1 HS
071 9.8 Bc
071 8.3 Fd
075 8.0 Wd
V CNC
081617
045 8.7 Ah
049 8.4 Ah
053 8.1 L
055 7.9 Pt
056 8.0 Ah
057 8.2 Ah
057 8.2 Wd
059 8.1 HS
060 8.2 Ch
061 8.0 Ah
062 8.1 Ah
066 7.8 Br
067 7.8 L
069 8.1 Wd
069 8.1 Gy
071 8.4 HS
RT HYA
082405
055 8.0 Pt
R CHA
082476
012 9.7 Bl
013 8.5 En
024 9.0 Bl
026 9.6 Ht
030 9.9 En
034 10.6 Sm
034 9.7 Bl
034 9.7 Ht
036 10.6 En
045 10.6 Bl
053 11.0 Bl
061 11.2 Bl
U CNC
083019
056 11.9 L
060 11.9 Ch
064 12.8 Br
071[13.3 Bw
X UMA
083350
055 11.3 Pt
S HYA
084803
045 8.4 Ah
052 8.5 Br
055 8.7 Pt
056 8.7 Ah
059 8.4 Jo
061 8.8 Ah
062 8.9 Ah
064 8.7 Jo
069 8.9 Jo
072 9.4 Jo
T HYA
085008
041 8.8 Ch
042 8.8 Tf
053 8.7 L
055 8.1 Pt
059 8.0 Jo
062 8.7 Tf
064 8.3 Jo
066 8.2 Br
069 8.0 Jo
077 8.0 L
072 7.7 Jo
T CNC
085120
056 8.6 BL
057 9.2 BL
059 7.8 Jo
060 9.3 Ch
061 9.4 Ah
064 8.0 Jo
064 8.9 BL
067 9.1 BL
067 8.0 Jo
072 8.1 Jo
072 8.8 BL
074 8.6 BL
076 8.5 BL
078 9.0 BL
T PYX
090031
034 [w Bl
061 [u Bl
V UMA
090151
037 10.8 L
049 10.5 L
065 10.5 L
W CNC
090425
056 12.7 L
063 12.5 Br
RX UMA
090567
037 10.7 L
049 10.3 L
065 11.2 L
RW CAR
091868
010 14.9 Dr
030[12.8 En
034[12.8 Ht
034[13.5 Bl
061 13.6 Bl
Y VEL
092551
010 14.4 Dr
012 13.4 Bl
026 12.9 Ht
034 13.5 Bl
045 13.8 Bl
054 13.5 Bl
061 13.9 Bl
R CAR
092962
011 6.8 En
011 6.5 Dr
012 6.9 Bl
024 7.3 Bl
026 8.1 Ht
030 8.0 En
034 7.9 Sm
034 8.0 Ht
034 8.1 Bl
036 9.2 En
045 8.4 Bl
053 8.2 Dr
054 8.9 Bl
060 8.8 Dr
R CAR
092962
061 9.1 Bl
X HYA
093014
018 10.5 Nz
030 9.5 Nz
036 8.7 Ch
041 8.8 Ch
054 8.5 Nz
055 8.4 Pt
069 9.2 Gy
Y DRA
093178
056 13.4 L
R LMI
093934
041 11.5 Ch
052 11.8 Bc
055 11.1 Pt
057 11.7 Fd
063 11.7 Br
071 11.0 Fd
071 10.5 Bc
081 10.5 Al
088 8.7 Bc
RR HYA
094023
060 12.5 Dr
012[12.8 En
R LEO
094211
036 9.6 Ch
040 8.9 Cv
041 9.0 Bc
042 9.0 Tf
042 9.0 Ah
045 8.9 Ah
051 8.7 Ch
052 8.7 Jo
053 9.1 Tf
055 8.9 Cv
055 8.0 Pt
056 8.5 Ah
056 8.5 Jo
056 8.4 BL
056 8.9 Sf
056 8.6 Tf
056 8.9 Wd
056 7.7 Ma
057 8.8 Wd
057 8.3 Fd
057 8.6 Ah
059 8.2 Jo
059 8.6 Wd
061 8.5 Ah
062 8.4 Ah
062 8.5 Tf
063 7.6 Jo
064 8.9 BL
R LEO
094211
064 8.7 Sf
067 9.0 BL
067 7.7 Ma
068 8.4 Ah
069 8.8 Wd
070 8.7 Sc
070 8.7 Cv
070 8.6 Hs
071 7.8 Fd
071 8.5 Sf
072 8.7 Wd
072 7.5 Bc
072 8.6 BL
074 8.5 BL
074 8.5 Ll
074 8.6 Hs
075 8.3 Wd
076 7.6 Ma
076 8.1 BL
077 7.9 BL
078 7.9 BL
081 8.8 Ll
081 8.5 Hs
081 7.5 Al
088 7.5 Bc
Y HYA
094622
014 7.5 En
030 7.5 En
036 6.8 Ch
055 6.5 Pt
Z VEL
094953
011 12.6 Dr
012 12.7 Bl
024 13.1 Bl
030[12.8 En
034 13.4 Bl
045 13.8 Bl
054[13.5 Bl
057[13.6 Dr
V LEO
095421
055 10.7 Pt
056 10.4 Sf
064 10.5 Sf
064 11.5 BE
066 10.6 Br
069 11.6 BE
RR CAR
095458
014 8.0 En
026 8.4 Ht
030 8.1 En
034 8.4 Ht
RV CAR
095563
010 14.7 Dr

VARIABLE STAR OBSERVATIONS RECEIVED DURING APRIL, 1930.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
RV CAR	U HYA	W LEO	W CEN	Y VIR	RS UMA
095563	*103212*	104814	*115058*	*122803*	123459
012[13.5 Bl	986 6.0 Kd	044 14.2 Nz	012 10.2 Bl	030 14.8 Nz	065 9.4 Bn
024[13.1 Bl	998 6.0 Kd	062 14.4 L	014 10.3 En	038 15.0 Nz	066 9.6 Nz
026[13.1 Ht	000 5.8 Kn	064[13.4 Br	024 9.5 Bl	044 14.9 Nz	066 9.4 Br
034[13.1 Ht	002 5.6 Kn	067[13.7 B	026 9.9 Ht	054[13.9 Nz	069 9.8 Bn
045 12.9 Bl	004 5.7 Kn	RS CAR	030 9.2 En	063 14.6 L	069 10.0 Wd
054 11.8 Bl	011 5.6 Kn	*110361*	034 9.1 Sm	066 14.5 Nz	069 9.3 Ma
060 11.5 Dr	012 5.9 Kd	034[12.3 Sm	034 9.4 Ht	067[13.2 B	071 9.8 Fd
061 11.4 Bl	028 5.7 Kn	S LEO	034 8.6 Bl	067[12.9 Ma	072 9.8 Wd
063 11.4 Dr	029 5.6 Kn	110506	045 8.2 Bl	U CEN	075 9.9 Wd
S CAR	033 5.7 Kn	041[13.1 Ch	054 8.0 Bl	*122854*	075 10.2 BE
100661	053 5.7 Kd	056 13.8 L	055 7.5 Dr	012 11.6 Bl	S UMA
011 7.5 Dr	056 5.3 L	063 13.7 Br	060 7.6 Dr	014 11.0 En	123961
012 7.4 Bl	058 5.8 Kd	RY CAR	062 8.2 Bl	024 10.5 Bl	039 8.5 Ch
013 7.1 En	060 5.5 Ch	*111561*	R COM	029 10.6 Ht	042 8.5 Ah
024 8.4 Bl	066 6.0 Kd	014[13.1 En	115919	034 10.1 Ht	044 8.5 Lj
026 8.6 Sm	070 6.0 Kd	026[13.1 Ht	041 10.6 Ch	034 10.2 Bl	045 8.5 Ah
026 8.3 Ht	RZ CAR	030[13.1 En	055 8.8 Pt	045 9.7 Bl	049 8.3 Ah
030 8.7 En	*103270*	034[13.5 Bl	059 8.8 Jo	054 9.4 Bl	051 8.6 Lj
034 8.7 Ht	014[12.4 En	053[13.3 Dr	064 8.5 Br	055 9.1 Dr	052 8.2 Jo
034 8.8 Sm	026[13.1 Ht	060 13.6 Dr	065 8.7 Jo	060 8.7 Dr	055 8.0 Pt
034 8.5 Bl	034[13.1 Ht	062[13.5 Bl	067 8.5 Jo	062 8.5 Bl	056 8.3 Ah
045 8.3 Bl	055[13.6 Dr	RS CEN	072 8.2 Jo	063 8.6 Dr	056 8.2 Ma
053 8.1 Dr	R UMA	*111661*	SU VIR	T UMA	056 8.6 Wd
054 7.7 Bl	103769	011 8.1 Dr	120012	123160	056 8.0 Jo
057 7.6 Dr	041 10.6 Ch	012 8.5 Bl	041 8.8 Ch	055 12.4 Pt	057 8.3 Fd
060 7.2 Dr	055 11.3 Pt	014 8.3 En	055 9.5 Pt	056[12.4 Ma	057 8.3 Lj
061 7.1 Bl	056 10.9 HS	024 8.5 Bl	071 10.5 Bw	066 12.2 Br	057 8.3 Ah
U UMA	056 11.5 Ah	026 9.0 Ht	T VIR	067 12.4 B	059 8.7 Wd
100860	057 11.0 Fd	030 8.6 En	*120005*	069 12.1 Ma	061 8.1 Ah
060 6.6 Ch	064 11.1 HS	034 8.6 Sm	041 11.8 L	R VIR	062 8.1 Ah
Z CAR	066 11.6 Br	034 9.0 Ht	055 12.0 Pt	123307	063 8.2 Lj
101058a	067 11.8 B	034 9.1 Bl	061 11.8 Ch	036 9.4 Ch	065 8.2 Lj
011 12.3 En	071 11.4 Fd	045 9.3 Bl	063 12.1 L	055 10.5 Pt	065 7.8 Jo
012 11.7 Bl	V HYA	053 9.4 Dr	R CRV	056 10.3 Ah	066 8.0 Ah
024 12.1 Bl	*104620*	054 9.9 Bl	*121418*	056 10.5 Hs	066 8.1 Lj
026 12.3 Ht	012 7.3 Bl	060 10.0 Dr	018 9.6 Nz	056 10.4 Ma	068 7.8 Ah
034 12.4 Ht	024 7.4 Bl	062 10.6 Bl	030 9.9 Nz	057 9.9 Fd	069 8.8 Wd
034 12.5 Bl	034 7.5 Bl	X CEN	037 10.5 L	061 10.2 Ah	069 7.9 Ma
045 12.8 Bl	036 7.5 Ch	*114441*	038 10.5 Nz	067 10.1 Ma	071 7.6 Fd
054 13.2 Bl	045 6.8 Bl	011 12.1 Dr	044 11.0 Nz	068 10.2 Ah	072 8.7 Wd
061 13.1 Bl	054 7.0 Bl	012 12.4 Bl	054 11.2 Nz	070 9.8 Hs	072 7.4 Jo
W VEL	055 6.5 Pt	026 12.4 Ht	055 11.3 Pt	071 9.9 Fd	075 8.5 Wd
101153	056 6.7 L	034 12.7 Ht	057 11.3 Fd	076 10.1 Ma	RU VIR
012 11.8 Bl	060 6.8 Ch	034 12.8 Bl	063 11.3 L	RS UMA	124204
014 12.0 En	062 6.8 Bl	045 13.4 Bl	066 11.6 Nz	123459	037 9.4 L
024 11.5 Bl	RS HYA	054 13.5 Bl	SS VIR	018 10.5 Nz	055 9.7 Pt
026 11.9 Ht	*104628*	062 13.6 Bl	122001	030 9.4 Nz	061 10.2 Ch
030 11.4 En	012 11.6 Bl	AD CEN	037 8.8 L	038 9.2 Nz	063 9.6 L
034 10.5 Sm	024 11.0 Bl	*114858*	049 8.4 L	039 9.2 Ch	070 10.9 Hs
034 11.4 Ht	034 10.3 Bl	011 9.2 En	065 9.1 L	044 9.5 Nz	071 10.7 Bw
034 10.7 Bl	045 9.8 Bl	026 9.5 Ht	T CVN	054 9.3 Nz	U VIR
045 9.5 Bl	054 10.0 Bl	030 9.2 En	122532	054 9.2 Bn	124606
054 9.1 Bl	062 10.1 Bl	034 9.1 Sm	041 11.1 Ch	055 9.0 Pt	037 12.4 L
055 9.0 Dr	W LEO	034 9.4 Ht	055 11.9 Pt	056 8.9 Ma	055 12.4 Pt
060 8.6 Dr	104814	W CEN	071[12.1 Fd	056 9.7 Wd	063 12.6 L
062 8.9 Bl	018[13.5 Nz	*115058*	Y VIR	057 9.3 Fd	071[12.2 Fd
063 8.5 Dr	030 14.6 Nz	011 9.9 Dr	*122803*	059 9.9 Wd	
	038 14.3 Nz	011 10.7 En	018 13.9 Nz	060 9.3 Bn	

VARIABLE STAR OBSERVATIONS RECEIVED DURING APRIL, 1930.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
RV VIR	T UMI	T APS	S BOO	Y LUP	RU LIB
130212	133273	*134677*	141954	*145254*	*152714*
041 14.4 L	070 10.7 Jo	012 12.4 Bl	069 10.2 Gb	057 14.1 Dr	041 8.6 L
067[13.8 L	071 11.9 Fd	029[12.7 Ht	072 11.0 Jo	062[13.7 Bl	066 8.6 Pt
U OCT	T CEN	034[13.2 Ht	076 11.0 BL	S APS	067 8.2 L
131283	*133633*	039 13.2 Bl	RS VIR	*145971*	R NOR
026 12.9 Ht	011 8.7 Dr	054[13.2 Bl	142205	011 10.7 Dr	*152849*
030 12.9 En	012 8.5 Bl	057[13.6 Dr	018 10.4 Nz	012 10.9 Bl	012 11.5 Bl
034 12.7 Ht	024 7.0 Bl	RR VIR	030 10.8 Nz	024 10.8 Bl	029 12.5 Ht
034 12.4 Bl	029 6.7 Ht	*135908*	038 11.1 Nz	029 10.8 Ht	039 12.3 Bl
034 12.4 Sm	034 6.5 Bl	056 14.1 Hs	041 11.3 L	034 10.7 Sm	054 12.4 Bl
036 12.0 En	045 6.5 Bl	070 14.2 Hs	044 11.4 Nz	034 10.7 Ht	057 12.6 Dr
045 11.9 Bl	054 6.4 Bl	Z BOO	066 12.2 Nz	039 10.9 Bl	060 12.6 Dr
054 11.4 Bl	055 6.3 Dr	140113	067 12.4 L	053 10.5 Dr	062 12.5 Bl
060 11.5 Dr	057 6.4 Dr	057 14.5 L	V BOO	054 10.8 Bl	X LIB
062 11.1 Bl	058 6.1 Kd	076[12.6 Ma	142539a	057 10.5 Dr	*153020*
W VIR	060 6.2 Dr	Z VIR	986 7.8 Kd	060 10.5 Dr	039[12.4 Bl
132002	062 6.4 Bl	*140512*	036 8.2 Ch	062 10.8 Bl	062[12.8 Bl
056 9.3 Ah	063 6.4 Dr	041 11.8 L	045 8.3 Ah	063 10.4 Dr	W LIB
V VIR	065 6.3 Kd	067 12.7 L	049 8.3 Ah		*153215*
132202	070 6.5 Kd	RU HYA	050 8.5 Sc	RT LIB	057[13.5 Dr
037 11.4 L	RT CEN	*140528*	050 8.9 Cv	*150018*	062[12.5 Bl
061[11.7 Ch	*134236*	012 12.2 Bl	056 8.7 Jo	066 13.5 Pt	S UMI
063 12.7 L	005 9.5 Dr	029 13.0 Ht	056 8.4 Ah		153378
R HYA	011 9.6 Dr	039 13.3 Bl	056 9.2 Sf	T LIB	051 11.8 Lj
132422	012 9.4 Bl	057 13.4 Dr	057 8.8 Fd	*150519*	056 11.5 Lj
012 6.0 Bl	024 9.6 Bl	062 13.4 Bl	062 8.7 Ah	041 14.1 L	059 11.5 Jo
029 7.6 Ht	029 10.4 Ht	R CEN	064 8.6 Pt		061 11.4 Ch
034 7.1 Bl	034 11.0 Bl	*140959*	064 8.9 Jo	Y LIB	062 11.5 Ah
041 6.6 L	045 11.3 Bl	011 8.2 Dr	067 8.9 Sf	*150605*	063 11.7 Lj
045 7.4 Bl	054 11.7 Bl	012 8.8 Bl	069 8.5 Gb	041 10.6 L	066 11.7 Lj
047 7.7 Ch	055 11.4 Dr	024 8.7 Bl	070 8.7 Jo	066 8.1 Pt	066 11.5 Pt
054 7.3 Bl	060 11.8 Dr	029 9.5 Ht	070 8.9 Sc	067 8.4 L	067 11.3 Jo
062 7.9 Bl	062 11.9 Bl	034 9.7 Ht	070 8.9 Cv		070 11.4 Jo
058 7.5 Pt	R CVN	034 9.5 Bl	071 9.1 Fd	S LIB	U LIB
066 8.3 Kd	134440	054 9.6 Bl	R CAM	*151520*	*153620a*
067 8.3 L	056 9.6 Ah	055 9.4 Dr	142584	041 11.0 L	039[12.4 Bl
S VIR	057 9.6 Ah	060 9.4 Dr	064 13.4 Br	057 10.6 L	057[13.1 Dr
132706	057 9.0 Fd	062 10.1 Bl	R BOO	066 10.2 Pt	062[12.9 Bl
029 12.0 Ht	058 8.7 Pt	U UMI	143227	S SER	T NOR
047 10.8 Ch	060 9.0 Ch	141567	036 11.0 Ch	151714	*153654*
058 11.1 Pt	061 9.2 Ah	051 10.8 Lj	051 11.9 Lj	041 13.5 L	029[12.8 Ht
059 11.2 Jo	062 9.3 Ah	062 10.7 Ah	056 11.8 Jo	057[11.9 Fd	057 13.6 Dr
064 10.5 Jo	069 8.1 Gy	063 10.4 Lj	059 11.7 Jo	067 13.8 L	060[13.5 Dr
069 9.4 Jo	071 8.2 Fd	064 10.1 Pt	062 12.2 Lj	071[11.8 Fd	Z LIB
RV CEN	076 8.0 BL	065 9.7 Jo	063 12.3 Lj	071[12.1 Ma	*154020*
133155	078 8.1 BL	066 10.0 Lj	064 12.2 Pt	S CRB	060[13.6 Dr
012 9.5 Bl	RX CEN	067 9.7 Jo	066 12.5 Lj	151731	062[12.7 Bl
024 9.5 Bl	*134536*	069 10.0 Gb	067 12.0 Jo	057 10.5 Fd	R CRB
029 10.2 Ht	011 9.6 Dr	072 9.3 Jo	V LIB	061 11.8 Ch	154428
034 10.5 Ht	012 10.0 Bl	S BOO	*143117*	066 11.4 Pt	978 6.0 Kn
034 9.8 Bl	029 10.9 Ht	141954	041 13.7 L	071[11.8 Fd	986 6.2 Kd
045 9.7 Bl	034 11.2 Bl	036 9.2 Ch	067[13.1 L	RS LIB	000 6.0 Kn
054 9.6 Bl	045 11.2 Bl	042 9.8 L	U BOO	*151822*	011 5.9 Kn
062 9.5 Bl	054 11.6 Bl	056 10.0 Jo	144918	029 8.1 Ht	036 6.0 Ch
T UMI	055 11.4 Dr	063 10.2 Gb	072 10.8 Bw	039 8.1 Bl	037 6.0 L
133273	060 11.9 Dr	064 10.8 Pt	Y LUP	041 7.9 L	041 6.0 L
057 12.6 L	062 12.4 Bl	064 10.4 Jo	*145254*	054 7.4 Bl	042 6.0 Ch
064 11.0 Jo		067 10.6 L	012[12.4 Bl	062 8.2 Bl	043 5.9 L
064 12.6 Br		067 10.8 Jo	039[13.7 Bl	067 8.3 L	044 6.0 L

VARIABLE STAR OBSERVATIONS RECEIVED DURING APRIL, 1930.

J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs.

R CrB
154428
045 5.9 Ah
045 6.0 Ah
046 6.0 L
049 6.0 L
051 6.2 Lj
052 5.9 Jo
054 6.0 Gb
055 6.3 Sb
055 6.1 Pt
056 6.2 Sb
056 6.2 Wd
056 6.0 Jo
056 6.1 Ah
057 6.1 Wd
057 6.2 Pt
057 6.1 Ah
057 6.0 L
057 6.1 Fd
058 6.1 Pt
058 6.2 Kd
059 6.0 Jo
059 6.3 Sb
059 6.0 Wd
060 6.3 Sb
061 6.2 Sb
061 6.0 Ah
061 6.0 L
061 5.9 Ch
062 6.2 Sb
062 6.1 Ah
062 6.1 L
063 6.0 L
063 6.3 Sb
063 5.9 Tf
063 6.1 Lj
063 6.1 Pt
064 6.1 Pt
064 6.0 Jo
064 6.1 Lj
066 6.2 Lj
066 6.0 Gy
066 6.1 Kd
066 6.1 Pt
067 6.0 L
068 5.9 Ah
068 6.2 Pt
069 5.9 Gy
069 6.0 Wd
069 6.0 Gb
070 6.1 Kd
070 6.1 Pt
071 6.1 Pt
071 6.0 HS
071 6.1 Fd
072 6.0 Wd
072 6.0 Jo
075 6.2 Pt
075 6.0 Wd

R CrB
154428
076 6.1 Pt
077 6.1 Pt

X CrB
154536
042 11.5 L
064 10.6 L
066 11.2 Pt

R Ser
154615
061 9.7 Ch
066 9.7 Pt

V CrB
154639
066 10.3 Pt
072 10.2 Bw

R Lib
154715
041 14.0 L
063[13.5 L

R Lup
154736
057 12.6 Dr
063 12.5 Dr

RR Lib
161122a
155018
041 8.6 L
060 8.1 Dr
063 8.8 L
068 8.8 Pt

Z CrB
155229
043 13.0 L

RZ Sco
155823
029 10.7 Ht
068 11.8 Pt

Z Sco
160021
029[11.8 Ht
043 12.1 L
062[11.8 Bl
067 12.1 L

R Her
160118
057 9.0 Fd
068 9.3 Pt
071 9.4 Fd

U Ser
160210
057[12.3 Ma
057[12.3 Fd
068 12.6 Pt
069[12.0 Ma

X Sco
160221a
062 12.7 Bl

SX Her
160325
043 8.5 L
055 8.0 Pt
057 8.4 Pt
057 8.7 L
058 8.4 Pt
063 8.5 Pt
064 8.2 Pt
066 8.3 Pt
068 8.3 Pt
070 8.2 Pt
071 8.2 Pt
075 8.1 Pt
076 8.0 Pt

W Sco
160519
060[13.6 Dr
062[12.6 Bl

RU Her
160625a
043 12.0 L
068 11.9 Pt
071[12.0 Fd

R Sco
161122a
018 14.7 Nz
030 14.5 Nz
038 14.3 Nz
044 14.1 Nz
057 13.3 Nz
062 12.8 Bl
066 12.5 Nz
068 12.5 Pt

S Sco
161122b
018 13.5 Nz
030 13.7 Nz
038 14.0 Nz
044 14.4 Nz
066 14.6 Nz
068 13.6 Pt

W CrB
161138
064 9.9 Jo
068 9.7 Pt
069 9.6 Jo
071 9.7 Fd
072 9.6 Jo

W Oph
161607
043 13.1 L
063 12.5 L
068 12.4 Pt

V Oph
162112
040 8.2 Ch
041 7.6 L
057 7.7 L
063 8.3 Tf

V Oph
162112
068 7.8 Pt

U Her
162119
046 10.8 Ch
056 10.9 Ah
057 11.3 Fd
059 11.0 Jo
064 11.0 Jo
067 11.2 Jo
068 11.1 Pt
070 11.4 Jo
071 11.0 Fd

Y Sco
162319
043[13.5 L

SS Her
162807
031 12.4 L
049 13.2 L
063 12.9 L
068 12.2 Pt

T Oph
162815
043 11.6 L
046 11.4 Ch
060 10.0 Dr
062 9.6 Bl
063 10.0 L
068 9.8 Pt

S Oph
162816
043 14.3 L
046[12.5 Ch
060[13.8 Dr

W Her
163137
040 9.3 Ch
056 9.8 Jo
057 10.1 Fd
059 10.0 Jo
067 10.6 Jo
068 10.7 Pt
070 10.8 Jo

R UMi
163172
059 9.7 Jo
064 9.6 Jo
069 9.6 Jo
072 9.5 Jo

R Dra
163266
036 8.5 Ch
045 8.0 Ah
049 7.8 Ah
051 7.8 Lj
052 7.9 Jo
056 7.7 Ah
056 7.5 HS

R Dra
163266
057 7.6 Ma
057 7.8 Ah
059 7.7 Jo
061 7.6 Ah
062 7.6 Ah
063 7.8 Lj
065 7.4 Jo
066 7.6 Lj
068 7.4 Pt
068 7.8 Ah
069 7.6 Ma
069 7.7 Gy
070 7.8 HS
071 7.4 Fd
072 7.3 Jo
076 7.6 HS

RR Oph
164310
018 12.1 Nz
030 12.8 Nz
038 13.6 Nz
043 14.0 L
044 14.0 Nz
057 14.6 Nz
066 14.5 Nz
068 13.2 Pt

S Her
164715
068 11.2 Pt

RS Sco
164844
029 11.9 Ht
039 11.3 Bl
054 10.8 Bl
060 10.6 Dr
062 10.7 Bl

RR Sco
165030a
029 12.1 Ht
060 10.1 Dr
062 11.3 Bl

RV Her
165631
037 9.8 L
049 9.8 L
059 9.8 Jo
063 9.9 L
064 9.6 Jo
067 9.9 Jo
068 9.7 Pt
070 9.7 Jo
072 10.1 Bw

RT Sco
165636
060[14.0 Dr

R Oph
170215
040 10.1 Ch

R Oph
170215
043 10.3 L
057 9.8 Fd
063 9.2 Tf
064 9.2 Jo
067 9.3 L
068 9.5 Pt
071 8.9 Fd

RT Her
170627
043 10.9 L
068 12.2 Pt

RW Sco
170833
062[12.5 Bl

Z Oph
171401
068 12.4 Pt

RS Her
171723
068 7.5 Pt
072 7.8 Bw

S Oct
172486
011 8.9 En
012 9.3 Bl
024 9.6 Bl
026 10.0 Ht
030 10.0 En
034 10.1 Sm
034 10.2 Ht
036 10.2 En
039 10.0 Bl
054 10.6 Bl
060 11.3 Dr
062 11.6 Bl

RU Oph
172809
043 10.9 L
057 9.8 L
068 9.5 Pt

RT Ser
173411
042 12.4 L

SV Sco
174135
060 12.0 Dr

W Pav
174162
012 11.5 Bl
029 12.5 Ht
039 12.6 Bl
060 13.3 Dr
062 13.0 Bl

U Ara
174551
060 12.2 Dr

VARIABLE STAR OBSERVATIONS RECEIVED DURING APRIL, 1930.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
RT OPH	RZ HER	RT LYR	RY SGR	T PAV	S CYG
175111	183225	185737	*191033*	*193072*	200357
043 10.0 L	044 10.1 L	042 10.7 Ch	063 8.0 L	062 11.7 Bl	061 11.7 L
068 11.0 Pt	067 9.0 L	046 11.3 L	063 8.0 Dr	RT CYG	063 11.3 Pt
RY HER	X OPH	V AQL	063 8.2 Pt	194048	R CAP
175519	183308	*185905*	064 8.0 Pt	040[11.3 Ch	*200514*
043 13.7 L	040 8.4 Ch	042 7.5 Ch	065 8.5 L	063 11.6 Pt	063[12.0 L
046 13.5 Ch	041 8.4 L	R AQL	067 8.5 L	063 11.8 Jo	S AQL
068 13.6 Pt	063 7.8 Jo	190108	070 9.0 Pt	067 11.8 Jo	200715a
V DRA	063 8.4 L	040 6.0 Ch	071 9.0 Pt	TU CYG	063 10.9 Pt
175654	067 8.0 Jo	056 7.3 Ah	075 8.9 Pt	194348	RW AQL
043 11.0 L	068 8.0 Pt	057 7.5 Ah	TY SGR	040[11.2 Ch	200715b
068 9.6 Pt	071 8.1 Fd	061 7.6 Ah	*191124*	046 12.1 L	063 9.6 Pt
R PAV	RY LYR	068 7.6 Ah	060 9.5 Dr	057 10.7 Ma	R TEL
180363	184134	068 7.0 Pt	S SGR	063 11.0 Pt	*200747*
029[11.9 Ht	036 13.2 L	V LYR	*191319a*	071 10.8 Ma	060 9.3 Dr
060 12.7 Dr	042[13.3 Ch	190539a	047[12.4 Ch	X AQL	RU AQL
T HER	056 12.5 L	047[12.3 Ch	TZ CYG	194604	200812
180531	068 12.4 Pt	RX SGR	191350	064 14.1 L	056 12.5 L
039 9.0 Ch	R SCT	*190818*	068 10.0 Pt	χ CYG	Z AQL
043 9.0 L	*184205*	047 12.0 Ch	U LYR	194632	*200906*
057 11.0 Fd	951 5.6 Kd	RW SGR	191637	046[12.0 Ch	066 13.0 Nz
063 11.7 L	036 5.4 Ch	*190819a*	057 11.0 Fd	057[12.0 Ma	RS CYG
068 11.8 Pt	041 5.0 L	047 9.7 Ch	068 10.2 Pt	063 12.7 Pt	200938
W DRA	042 5.6 Ch	057 9.8 L	071 11.0 Fd	071[12.6 Ma	036 7.8 Ch
180565	046 5.2 L	068 9.0 Pt	AF CYG	S PAV	040 7.8 Ch
043[14.1 L	049 5.0 L	TY AQL	192745	*194659*	046 7.8 Ch
068 11.8 Pt	051 5.7 Lj	*190907*	045 7.5 Ah	060 8.2 Dr	056 7.5 L
TV HER	057 5.5 Tf	068 10.3 Pt	056 7.8 Ah	RR SGR	063 8.5 Jo
181031	057 5.3 L	X LYR	057 7.8 Ah	*194929*	064 7.6 Pt
043 10.4 L	063 5.3 L	190926	061 7.7 Ah	060 6.7 Dr	067 8.2 Jo
067 10.4 L	063 5.8 Lj	068 8.7 Pt	062 7.8 Ah	RU SGR	070 7.8 Gb
RY OPH	063 5.9 Pt	RS LYR	068 7.8 Ah	*195142*	071 7.5 Fd
181103	064 5.8 Lj	190933a	TY CYG	060 7.6 Dr	R DEL
068 9.3 Pt	064 5.6 Tf	046 11.5 L	192928	RR AQL	201008
W LYR	064 5.9 Pt	068 10.6 Pt	046 11.4 Ch	*195202*	063 8.5 L
181136	066 5.8 Lj	RU LYR	046 12.1 L	056 12.1 L	064 8.0 Pt
044 10.8 L	068 5.8 Pt	190941	068 10.8 Pt	RS AQL	SX CYG
063 11.0 Jo	070 5.9 Pt	046 13.0 L	RT AQL	*195308*	201130
067 11.3 Jo	070 6.0 Gb	U DRA	193311	064 14.2 L	064 10.5 Pt
067 11.9 L	070 5.3 Kd	190967	042 14.3 L	Nov CYG	065 10.4 L
068 11.4 Pt	071 5.5 Fd	049 13.1 L	046[12.3 Ch	195553	RT SGR
RV SGR	071 5.8 Pt	068 13.2 Pt	R CYG	058[12.2 Pt	*201139*
182133	075 5.6 Pt	T SGR	193449	066[12.2 Pt	060 13.2 Dr
060 10.5 Dr	Nov AQL	*191017*	046[12.4 Ch	075[12.2 Pt	WX CYG
SV HER	184300	047 10.8 Ch	057 11.9 Ah	Z CYG	201437b
182224	040 10.7 Ch	049 10.7 L	062 11.5 Ah	195849	064 9.3 Pt
044 10.1 L	063 11.6 Pt	068 11.0 Pt	063 12.5 Pt	046 9.9 Ch	065 9.4 L
068 9.6 Pt	068 11.7 Pt	R SGR	RV AQL	049 10.0 L	071 11.5 Fd
T SER	070 11.6 Pt	*191019*	193509	063 9.5 Pt	U CYG
182306	075 11.6 Ch	047 11.6 Ch	046 10.1 L	SY AQL	201647
046[12.2 Ch	RX LYR	061 12.0 L	063 11.7 Pt	200212	063 11.5 Jo
SV DRA	185032	068 12.0 Pt	T PAV	056 12.4 L	064 9.3 Pt
183149	042[13.0 Ch	RY SGR	*193072*	063 11.9 Pt	067 11.7 Jo
044 9.7 L	ST SGR	*191033*	012 9.5 Bl	BU CYG	071 10.7 Fd
057 9.7 Ma	*185512a*	044 6.4 L	023 9.8 Bl	200250	U MIC
063 9.4 L	042[12.5 Ch	049 7.1 L	029 9.5 Ht	051[12.5 Lj	*202240*
069 9.7 Ma	Z LYR	056 7.5 L	039 10.4 Bl	066[12.8 Lj	060 12.9 Dr
	185634	060 7.9 Dr	054 11.6 Bl		
	042[12.3 Ch	061 8.0 L	060 11.8 Dr		

Variable Star Observations Received During April, 1930.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
RU Cap	RZ Cyg	T Cep	RV Cyg	RW Peg	RR Cas
202622	204846	210868	213937	*225914*	235053
066 9.5 Nz	064 12.5 Pt	056 9.0 Ah	064 6.3 Pt	012[13.2 Nz	054 11.6 Bn
Z Del	S Ind	057 9.3 Ah	RR Peg	V Cas	060 11.6 Bn
202817	204954	057 8.7 Fd	214024	230759	065 11.5 Bn
065 13.4 L	060[13.5 Dr	059 9.0 Jo	064 11.0 Pt	042 7.8 Ah	R Phe
ST Cyg	X Del	061 9.2 Ah	R Gru	045 7.9 Ah	*235150*
202954	205017	062 9.3 Ah	*214247*	049 7.9 Ah	006 8.2 Dr
061 11.7 L	063 9.7 L	064 9.2 Jo	012 8.2 Bl	051 8.4 Sf	V Cet
064 11.2 Pt	064 9.5 Pt	068 9.4 Ah	023 7.8 Bl	056 8.5 Sf	*235209*
V Vul	RR Cap	068 9.0 Pt	V Peg	056 8.1 Ah	012 9.5 Bl
203226	*205627*	069 9.6 Gy	215605	057 8.2 Ah	R Tuc
064 8.6 Pt	060 8.3 Dr	070 9.1 Jo	061 9.7 L	057 8.1 Fd	*235265*
S Del	T Oct	RR Aqr	RZ Peg	061 8.6 Ah	006 10.2 Dr
203816	*205782*	*210003*	220133b	062 8.6 Ah	012 10.0 En
051 11.3 Lj	060[13.6 Dr	065 10.4 L	061 10.4 L	064 8.2 Pt	026 10.8 Ht
064 11.3 Lj	063[13.6 Dr	W Cyg	064 9.8 Pt	068 8.9 Ah	029 10.5 En
064 11.1 Pt	R Vul	*213244*	T Peg	W Peg	034 11.6 Ht
066 11.3 Ll	*205923a*	969 6.2 Kd	220412	231425	034 11.3 Sm
V Cyg	064 8.1 Pt	976 6.4 Kd	056 10.2 L	064 11.2 L	036 10.8 En
203847	TW Cyg	994 6.5 Kd	RV Peg	Z And	R Cas
061 12.7 L	210129	997 6.5 Kd	222129	232848	235350
064 13.0 Pt	061[13.5 L	001 6.4 Kd	061 11.0 L	064 10.2 Pt	038 7.2 Ch
Y Aqr	RS Aqr	024 6.1 Kd	S Lac	ST And	045 7.9 Ah
203905	*210504*	042 5.6 L	222439	233335	049 8.0 Ah
066 14.3 Nz	063 10.9 L	056 5.7 L	061 9.6 L	064 9.1 Lj	056 8.2 Ah
T Del	R Equ	063 5.4 Tf	064 9.4 Pt	066 9.0 Lj	057 8.4 Ah
204016	210812	064 5.7 L	R Ind	R Aqr	057 7.9 Fd
063 10.3 L	063 11.3 L	070 6.0 Kd	*222867*	*233815*	061 8.2 Ah
064 10.0 Pt	064 11.9 Pt	S Cep	012 9.6 Bl	969 8.6 Kd	062 8.5 Ah
V Aqr	T Cep	213678	023 9.3 Bl	997 8.6 Kd	071 9.0 Fd
204102	210868	068 9.5 Pt	044 9.7 Bl	012 9.0 Bl	Y Cas
065 9.3 L	036 8.5 Ch	RU Cyg	044 10.5 Bl	Z Cas	235855
W Aqr	045 8.7 Ah	213753	053 11.0 Bl	233956	039 10.8 Ch
204104	049 8.8 Ah	056 8.3 Ah	061 11.5 Bl	064 12.6 L	064 11.0 L
066 12.5 Nz	052 8.8 Jo	061 8.4 Ah			

Rapidly Varying Irregular Variables.

Star J.D.	Est.Obs.	J.D.	Est.Obs.	Star J.D.	Est.Obs.	J.D.	Est.Obs.
005840 RX Andromedae—				060547 SS Aurigae—			
6055.7	13.2 Pt	6075.9	11.5 Pt	6071.7	[12.6 Pt	6077.7	[11.5 Pt
6064.7	11.5 Pt			6072.5	[12.6 Bw	6081.6	12.0 Pt
060547 SS Aurigae—				6074.7	[13.3 Br	6081.6	11.5 Hs
6011.2	14.9 Nz	6051.6	[14.0 Lg	6075.7	[12.6 Pt	6081.6	11.6 Ll
6023.1	[14.5 Nz	6052.6	[13.9 Br	6076.7	[12.4 Pt		
6026.2	[15.2 Nz	6053.3	14.8 L	074922 U Geminorum—			
6030.1	10.8 Nz	6054.6	[13.8 B	6011.2	13.6 Nz	6053.4	13.8 L
6032.1	12.4 Nz	6055.7	[13.5 Pt	6023.1	13.5 Nz	6054.2	13.9 Nz
6032.1	12.4 Nz	6056.3	14.7 L	6032.1	14.0 Nz	6054.7	14.0 Br
6033.1	12.5 Nz	6057.6	[13.3 Bw	6034.1	13.8 Nz	6055.7	[13.3 Pt
6034.1	13.6 Nz	6062.3	14.8 L	6038.3	13.9 L	6056.0	13.9 Hs
6035.1	14.1 Nz	6063.1	15.2 Nz	6039.3	13.8 L	6056.4	13.8 L
6037.1	14.3 Nz	6064.7	[13.9 Br	6041.3	13.8 L	6057.7	[13.3 Pt
6038.3	14.8 L	6065.3	15.0 L	6042.3	13.8 L	6058.8	[12.4 Pt
6041.3	14.7 L	6066.7	[13.9 Br	6048.2	13.9 Nz	6062.3	13.8 L
6042.3	14.8 L	6067.3	[13.8 L	6051.6	13.7 Lg	6062.6	14.0 B
6045.1	[13.9 Nz	6068.7	[12.6 Pt	6051.7	14.0 Br	6063.1	13.9 Nz
6048.1	[14.5 Nz	6069.6	[13.7 B	6052.3	13.6 L	6063.4	13.9 L
6050.5	[11.7 Pt	6070.6	[14.2 Hs	6052.7	13.9 Br	6064.4	13.9 L

VARIABLE STAR OBSERVATIONS RECEIVED DURING APRIL, 1930.

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
074922 U GEMINORUM—						
	6064.7	14.4	Br	6070.6	14.0	Hs
	6065.3	14.0	L	6071.7	[13.3	Pt
	6066.3	14.0	L	6074.7	[13.2	Br
	6067.3	13.9	L	6075.7	[12.4	Pt
	6067.6	14.0	B	6076.7	[12.3	Pt
	6068.7	[12.4	Pt	6077.7	[11.0	Pt
	6069.6	13.9	B			
081473 Z CAMELOPARDALIS—						
	6037.6	11.7	L	6056.3	12.3	L
	6038.3	11.2	L	6057.6	12.2	L
	6039.3	11.4	L	6060.1	11.4	Ch
	6041.3	11.6	L	6061.6	10.9	L
	6042.3	11.7	L	6062.4	11.5	L
	6043.6	11.3	L	6063.3	11.6	L
	6044.7	11.4	L	6063.7	11.2	Br
	6046.6	12.0	L	6064.6	11.4	L
	6049.6	11.4	L	6064.7	11.4	Br
	6050.3	11.7	L	6065.3	11.6	L
	6052.3	11.7	L	6066.7	12.2	Br
	6052.7	11.2	Br	6067.3	12.0	L
	6053.4	11.6	L	6067.7	12.7	Br
	6053.7	11.5	Br	6068.7	12.7	Br
	6054.7	11.8	Br	6074.7	12.8	Br
094512 X LEONIS—						
	6018.4	[13.3	Nz	6050.3	[12.3	L
	6030.4	12.2	Nz	6052.3	12.3	L
	6038.3	[13.8	L	6052.7	12.4	Br
	6039.3	15.0	L	6053.4	12.7	L
	6049.6	[12.0	L	6054.7	[13.0	Br
094512 X LEONIS—						
	6056.4	[14.2	L	6065.3	[13.8	L
	6062.4	[14.7	L	6066.7	[14.2	Br
	6063.7	14.6	Br	6067.3	[14.7	L
	6064.7	[14.2	Br	6068.7	[13.0	Br
202946 SZ CYGNI—						
	6058.8	9.5	Pt	6068.8	9.0	Pt
	6063.9	9.0	Pt	6070.9	9.2	Pt
	6064.9	9.0	Pt	6071.9	9.3	Pt
	6066.8	9.0	Pt	6075.9	9.6	Pt
213943 SS CYGNI—						
	6037.7	11.8	L	6063.7	11.6	L
	6040.9	11.0	Ma	6063.9	11.7	Pt
	6041.7	11.3	L	6064.6	11.3	L
	6042.5	11.9	Ch	6064.6	11.8	Lj
	6043.7	11.6	L	6064.9	11.7	Pt
	6044.7	11.6	L	6065.6	11.0	L
	6046.7	11.6	L	6066.6	11.4	Lj
	6047.4	11.5	Ch	6066.6	11.2	Lj
	6049.7	11.6	L	6066.6	11.6	Lj
	6051.6	12.0	Lj	6066.7	10.7	L
	6052.6	11.8	Lj	6066.8	11.7	Pt
	6056.6	11.8	Ch	6068.5	8.6	Ah
	6056.7	11.3	L	6068.8	9.0	Pt
	6057.5	11.8	Ah	6070.9	8.9	Pt
	6057.8	11.9	Fd	6071.8	8.2	Fd
	6057.8	11.5	Ma	6071.9	8.8	Pt
	6058.8	11.6	Pt	6075.9	8.9	Pt
	6061.4	11.8	Ah	6076.7	8.6	Ma
	6061.6	11.4	L	6077.8	8.6	Ma
	6063.6	11.8	Lj			

SUMMARY OF OBSERVATIONS FOR APRIL, 1930.

Observer	Initial	Vars.	Observations	Observer	Initial	Vars.	Observations
Ahnert	Ah	38	119	Houghton	Ht	55	90
Allen	Al	7	7	Jones	Jo	43	144
Baldwin	Bl	74	304	Kanamori	Kn	2	10
Beloit College	BE	4	4	Kanda	Kd	14	63
Bigelow	Bw	6	7	Lacchini	L	165	370
Boutell	BL	9	46	Leiner	Lj	12	46
Bouton	Bo	38	41	Leslie	Ll	5	5
Brocchi	Br	24	55	Logan	Lg	10	10
Brown, A. N.	Bn	4	14	Marsh	Ma	15	31
Buckstaff	Bc	4	11	Nizamiah Obs.	Nz	30	137
Chandra	Ch	121	130	Peltier	Pt	179	286
Cohen	Cv	6	9	Schoenfeld	Sc	6	9
Dartayet	Dr	80	156	Smith, F. W.	Sf	11	25
Ensor	En	42	85	Smith, W. H.	Sm	19	20
Ford	Fd	37	56	Soberanes	Sb	2	8
Gaebler	Gb	7	8	Taffara	Tf	11	24
Gregory	Gy	6	7	Webb	Wd	8	36
Haas	HS	8	17				
Hawes	Hs	6	12	Totals		36	398 2402

May 14, 1930.

LEON CAMPBELL, Recording Secretary.

COMET NOTES

By G. VAN BIESBROECK.

COMET 1930 *d* (SCHWASSMANN-WACHMANN). The fourth new comet of this year was found in the beginning of May by the two German astronomers Schwassmann and Wachmann, whose names have jointly figured prominently in comet discoveries in late years. The comet was found on a plate exposed with the Lippert astrograph of the Bergedorf (Hamburg) Observatory. The following information was telegraphed on May 3 through the bureau of the Astronomical Union in Copenhagen.

May 2 at $0^h\ 38^m.2$ U.T. $\alpha = 16^h\ 1^m.7 + 35°\ 57'$. Mag. 9.5.
Daily motion 32′ in position angle 66° or 246°.

The comet was soon observed in various places, which showed that the object was moving northeastward in the constellation of the Northern Crown. Images of the object were also found on plates taken April 27 and 29 at Berlin-Babelsberg before the discovery. When first seen with the 40-inch refractor by the writer on May 4 the comet presented some resemblance to a spiral nebula seen edgewise.

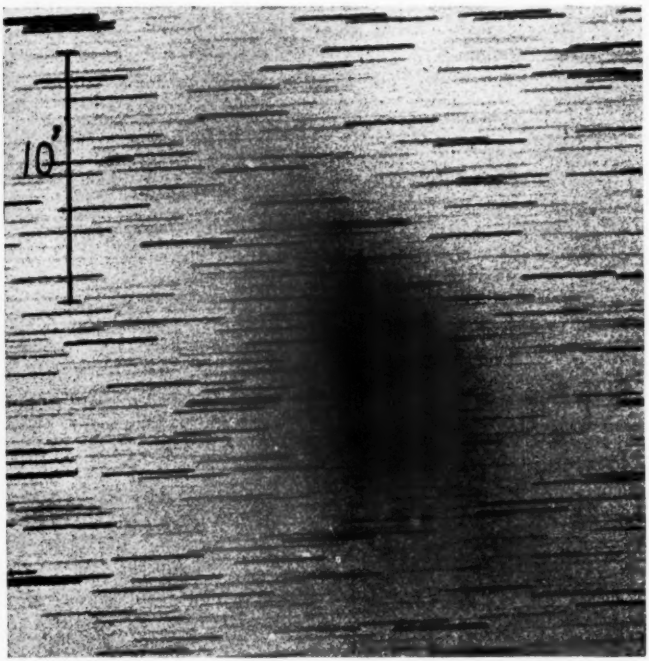


FIGURE 1.
COMET SCHWASSMANN-WACHMANN, 1930 MAY 24.

There was a nearly starlike nucleus of magnitude 12 in the center of a coma elongated in position-angle 15°-195°. Out of this came two streamers: the brighter one about 3′ long was in position-angle 206°; the other slightly fainter was in position-angle 8° and could be seen over a length of 2′.

When seen again on a moonless night (May 17) the northern streamer had become the brighter and both had reached about 5′ in length. The integrated brightness corresponded to about 8^M on that date.

The figure shows the appearance of the comet May 24, enlarged from a plate guided on the motion for 20 minutes with the 24-inch reflector. The brighter northern branch or tail could be traced to 20′ from the nucleus in the direction 24°; the southern one started out fainter but extended to fully 25′ in 224°. The latter tail is almost directly opposed to the direction of the sun, while the former makes only a small angle with that direction.

The following parabolic orbits have been computed:

Computer	M. Ebell	Whipple & Miss Hayford
Time of perihelion (U.T.)	1930 June 12.7904	1930 Jan. 12.96
Node to perihelion	187° 20′	190° 51′
Longitude of node	81 27	78 48
Inclination	20 24	21 2
Perihelion distance	1.030	1.016
Dates used	May 2.0, 2.9 and 3.9	May 2.9-3.9 and 5

The course of the comet is shown by the ephemeris:

1930	R.A. h m s	Decl. ° ′	Log. Δ
June 1	20 33 8	+15 45	8.984
5	21 58 7	— 0 13	8.977
9	23 4 54	13 54	9.049
13	23 53 12	22 33	9.146
17	0 27 4	27 38	9.237
21	0 51 55	30 43	9.318
25	1 10 0	32 46	9.386
June 29	1 23 20	—34 16	9.446

In the middle of May it has crossed the constellation of Hercules, reaching a maximum northern declination of 37°. Toward the end of the month the comet was rapidly moving southeastward while the brightness and apparent size increased because it was coming closer to the sun and to the earth. The minimum distance from the sun is about one astronomical unit so that no great physical activity is to be anticipated. But on June 3 the comet will be closest to the earth, from which it will then be less than 0.1 A.U., only 8 million miles away.

Pursuing its rapid course of about 6° a day it will get out of view for northern observers in the middle of June but will remain visible in the southern hemisphere. The maximum brightness is expected on June 3 when it may be as bright as a star of magnitude 7. The smallest telescope will show it then but naked-eye visibility is not anticipated.

Two of the comets previously announced this year are still under observation:

In the evening sky BEYER'S COMET (1930*b*) remains visible as a little round coma half a minute of arc in diameter (May 23). There is a sharp central nucleus. The brightness corresponds very closely to the computed value (see p. 310). Improved elliptic elements have been computed by Mr. and Mrs. C. H. Smiley from which the following ephemeris (*B.Z. der Astr. Nachr.* No. 20) has been deduced:

1930	R.A. h m s	Decl. ° ′	Log. Δ
June 1	7 54 21	+54 7.8	0.424
5	8 5 9	54 40.0	0.429
9	8 16 25	55 9.2	0.434
13	8 28 7	55 35.3	0.438
17	8 40 15	55 58.1	0.442
21	8 52 47	56 17.5	0.446
25	9 5 40	56 33.5	0.449
29	9 18 55	56 45.8	0.453
July 3	9 32 28	+56 53.9	0.456

The elements themselves have not been published. An observation by the writer on May 23 shows that the ephemeris is quite accurate. The object will probably be kept under observation for several months.

Wilk's Comet (1930 *c*) came closest to the earth about June 1. In the latter half of May it appeared as a large globular coma of nearly 10′ in diameter but with hardly any nucleus. By comparing it with the extra-focal images of stars it was found that the integrated light corresponded to that of an $8^{M}.5$ star (May 24). Yet it was not easy to see on account of the small surface brightness.

The following new orbit has been computed by Banachiewicz (*Circ. Copenhagen 278*):

Time of perihelion (U.T.)	= 1930 March 28.802	
Node to perihelion	= 46° 57′	} 1930.0
Longitude of node	= 90 16	
Inclination	= 67 8	
Perihelion distance	= 0.4818 A.U.	
Eccentricity	= 0.9923	
Period in years	= 494	

The suspected identity with De Vico's Comet (1846 IV) is not confirmed by this elliptic orbit. In June the comet will be well placed for observation in the constellations of Hercules and Ophiuchus but it will become a difficult object on account of its diminishing light and its extreme diffuseness.

Williams Bay, Wisconsin, May 26, 1930.

GENERAL NOTES

Dr. William Wallace Campbell will retire from the presidency of the University of California on July 1, 1930. By action of the regents of the University, Dr. Campbell is to have the title of president emeritus of the University of California and director emeritus and astronomer emeritus of Lick Observatory. He was invited by the regents to continue to serve as the director of the Lick Observatory but declined to accept this invitation feeling that he preferred to devote all of his energy to his astronomical studies. Dr. Campbell and Mrs. Campbell have accepted the invitation of the regents to occupy the residence on Mt. Hamilton which was built for them in 1894 and in which they resided continuously from that date until they came to the president's house in Berkeley in 1923. Because of the rigor of the winters on Mt. Hamilton it is probable that they will spend the winter months in Berkeley.

Perkins Observatory Appointments.— Information has been received from Dr. Harlan T. Stetson, Professor of Astronomy at Ohio Wesleyan University and Director of the Perkins Observatory, that appointments to the

staff for 1930-31 have been made as follows:

Dr. N. Wyman Storer, Instructor in Astronomy at Wesleyan University, to be Assistant Professor of Astronomy.

Dr. N. T. Bobrovnikoff, Research Associate at the Lick Observatory and National Research Fellow at the University of California, to be Assistant Professor of Astrophysics.

Mr. Marvin E. Cobb, A.B. Drake University, Fellow in Astronomy.

The Amateur Astronomers Association of New York City carried out the following program during the month of May: May 7, The A B C of Stars and Planets—A Talk for Beginners. May 21, Motion Pictures—"The Heavenly Bodies." Six reels of UFA film were shown.

American Association of Variable Star Observers will hold its Nineteenth Annual Spring Meeting at the Maria Mitchell Observatory, Nantucket, Massachusetts, on Saturday, June 14, 1930. Headquarters for the meeting will be the Observatory, on Vestal Street, where mail may be addressed.

A meeting of the Council will be held Friday evening, June 13, at 8:30 in the Observatory.

On Saturday morning the Observatory, the Maria Mitchell Memorial House and Library, and other places of interest will be open—also the Atlantic Ocean, for those who wish to swim. The regular business meeting of the Association is scheduled for 2:00 P.M. At this time brief reports of officers and committees will be presented. The nominating committee consisting of Miss Williams, Chairman, Mr. Allen, and Miss Harwood, will present its slate of new council members to be voted upon at the fall meeting. The rest of the meeting will be in the hands of members who have papers to present or who wish, less formally, to propose for discussion matters of interest to the Association.

A tea-party is planned for the latter part of the afternoon. At 7:00 o'clock will come the dinner at the Wonoma Inn, tickets $2.00.

Zodiacal Light Notes

Professor Joaquin Gallo, Director, Observatio Astronomico Nacional, Tacubaya, D.F. Mexico, sends the interesting information that under favorable conditions the Zodiacal Light can be seen from his station almost reaching the zenith one hour after sunset.

During the past month the writer has observed the Zodiacal Light only on the following dates, cloudy weather making observations impossible on otherwise favorable nights: April 19, 26, May 1, 2, 3, 15. On April 19, 8:15 to 8:45 P.M., the boundaries were quite diffuse, the northern boundary extended almost to Andromeda, and the Pleiades were slightly south of the median line. As the line of the Sun after sunset now swings northwest, so the direction of the Zodiacal Light keeps pace. From Regulus to the eastern horizon below Spica a faint zodiacal band of fairly even breadth, about 5°, was seen. On April 26, 8:20 to 8:40, the Zodiacal Light could be traced across the Milky Way below Gemini to Cancer and thence as a faint band to Regulus and Spica. As the sky darkened the Zodiacal Light stood out more distinctly in the west and the south boundary became sharp and clear-cut, the north boundary remaining diffuse. On May 1 at 8:30, moonlight made it difficult to note the boundaries but there was no doubt that the median line ran north of the line joining Venus and Jupiter. The general shape of the Zodiacal Light suggested an enormous pyramid tilted slightly

south from its west by north base. It may also be added that as the tilted direction of the Zodiacal Light becomes more pronounced the width of the base becomes greater correspondingly. On May 2 at 8:30, while the moonlight was fairly strong, the Zodiacal Light showed up as of slightly intenser luminosity than the surrounding sky. On May 15 at 9:00 P.M. the Zodiacal Light extended cone-shaped to Praesepe and was quite strong and steady in appearance. At 10:15 the oncoming moonrise was clearly indicated by a shaft of silvery light extending through Scorpio towards Libra.

The question of the nature of the spectrum of the Zodiacal Light is under discussion. So far as the writer knows the results obtained by Dr. E. A. Fath at the Lick Observatory over 20 years ago have received no serious criticism. Those results showed a continuous spectrum, that of reflected sunlight. It is possible, however, that at times of auroral disturbance the bright lines of that spectrum may be superimposed upon it. It is hoped that arrangements may be made to determine this point in the near future.

W. E. GLANVILLE.

The Rectory, New Market, Maryland, 1930 May 16.

BOOK REVIEWS

A Six-Place Table of the Trigonometric Functions, by Professor J. Peters. (Ferd. Dümmlers Publishing House, Berlin and Bonn. 52 marks.)

The above title is the English equivalent of the German title of this book. The unexpected feature of this volume is the fact that the values of the trigonometric functions themselves and not their logarithms, as has been customary, are here given to six places. To avoid too great differences, values are given throughout for each ten seconds of arc and for each second of arc for the cotangent and cosecant functions from 0° 0′ to 1° 20′. The size of the page is such as to provide space for ten minutes of arc thus requiring six pages for each degree. The obvious advantage of this table is in connection with computations made by the use of calculating machines instead of by logarithms, and this is significant because machines are being used more and more in scientific work. The book is well printed on good paper and is well bound. It fills a useful place in the computer's equipment.

This is the twelfth set of tables of various kinds by the same author.

Field Book of the Skies, by William T. Olcott and Edmund W. Putnam. (G. B. Putnam's Sons, New York and London.) Among the numerous books which have recently been added to the literature bearing on popular and elementary astronomy, this volume, which is convenient in size, attractive in appearance, and up-to-date in content, deserves special mention. The authors, themselves actively engaged in astronomical study and observation as amateurs, have prepared this volume largely, as they say in the preface, to stimulate not only a general interest in astronomy, but to encourage others to undertake definite observational work, which can well be done by amateurs. For guidance in such work, this volume is a library in itself.

For the general reader, also, the book has an important place. The reviewer, although fairly familiar with the basic and well-established facts of astronomy, found himself captivated by the style of presentation and was induced to read on and on merely for the pleasure of it.

Forty-one constellations are pictured, once for the naked eye and field glass and once for the telescope. Accompanying each is a brief mention of the objects of special interest in it, and also an account of the mythological references to it. There is a section on the Solar System, in which the moon receives careful attention. A very fine feature is a series of drawings of the moon as it grows from the slender crescent of the new moon to the completed circle of the full moon, thus enabling the observer to note the appearing of new features from night to night and to recognize them.

Most topics related to astronomy are touched upon in this volume. Comets, meteors, eclipses, all are discussed intelligently and succinctly. Thirteen pages are given to a chronological table, the first item of which is a reference to reports concerning celestial spheres in the 29th century B.C., the last a reference to the new Field Theory by Einstein in 1929.

In a word, any one interested in astronomical science will be delighted with the wealth of material packed in the 516 pages of this recent volume.

Handuch Der Astrophysik, Band III. Erste Hälfte. Grundlagen der Astrophysik. 475 pages. (Julius Springer, Berlin, 1930. 77 marks, bound.)

In this volume we have synthesized for us the remarkable astrophysical researches that are concerned with the constitution and atmospheres of the stars. So rapid indeed have been the strides in this particular line of investigation, most of which as a matter of fact has only taken place within the last decade, that theory has in several respects outstripped observation and must therefore impatiently await the decision of a comparison with present findings before venturing further. With the possible exception of Eddington's work on the internal constitution of the stars and Miss Payne's monograph on stellar atmospheres, there has been up to this time no available compendium of results so that the interested astrophysicist has often had to consult the original articles in the current literature. It is with a sigh of relief, then, that he can now leisurely turn over the pages of this fascinating volume and note the stupendous amount of work that has been accomplished in this field since the advent of the quantum theory.

The volume is divided into four chapters each of which is presented by a different author. The first chapter, by Professor W. Westphal of Berlin, reviews for us in German the energy laws of black bodies, their obvious connection with the quantum theory, the instrumental methods of measuring radiation, and the determination of the radiation constants, all of which is so essential for an understanding of the subject-matter which is to follow.

To Professor E. A. Milne of Oxford has fallen the Herculean task of writing the second chapter which he names, "Thermodynamics of the Stars," and he is to be heartily congratulated for his very able presentation. In this portion of the book consisting of 195 pages, we find incorporated much of his own work, notably that on the equilibrium of the chromosphere, together with the basic results of Schwarzschild and the later amplification by others on the theory of radiative equilibrium; also the investigations conducted chiefly by Emden and Lane on polytropic gas-spheres, by Eddington on the internal equilibrium of a star, and by von Zeipel and Jeans on the radiative equilibrium of a rotating star. Various other related considerations involving the calculation of the total energy of a star, the gravitational theory of stellar evolution, etc., are also included.

The third chapter written in German by Professor A. Pannekoek of Amsterdam, is entitled "Ionization in the Atmospheres of Stellar Bodies." The account is clear, orderly, and comprehensive. In the first section is given the theory of

thermal ionization and the subsequent derivation of the fundamental Saha formula of ionization later followed by the improved ionization formula as developed mainly by Darwin and Fowler from the viewpoint of statistical mechanics. A discussion of the mechanism of ionization processes is also inserted. A further section is devoted to the constitution of stellar atmospheres, another to Russell's researches on ionization in the solar atmosphere and a final section to ionization phenomena in stellar spectra.

"The Principles of Quantum Theory" by Professor S. Rosseland of Oslo (in English) constitutes the final chapter. The author first introduces us to the conception of the older quantum theory of Bohr and its fundamental postulates, and then as a step towards its later development to the Hamilton-Jacobi integration theory as modified by relativistic mechanics. The succinct presentation of the recent wave mechanics in accounting for various atomic and molecular phenomena is indeed a praiseworthy achievement. The third and last section of the chapter contains an account of the stellar absorption coefficient.

It is the opinion of the writer that this volume is the most interesting one of the Handbuch series that has yet appeared. To those working in the ever changing field of astrophysics it will beyond a doubt be of incalculable aid in many avenues of research investigation. L.B.

THE GOAL OF PROGRESS

The stars are suns, the sun's a star,
And what and where and why they are
We *know*—we do not have to grope
For facts—we have the spectroscope.
Great glasses sweep the studded skies
And science follows on surmise:
Dim globes sunk deep in space we see,
We prophesy what is to be;
Events far distant we can tell,
We know our universe as well
As once this world whereon we move
We knew—all, all things now we prove,
And, holding fast what's apt and good,
Work surely on to brotherhood.

—William R. Shields.

728 Hancock Street, Brooklyn, New York.

Note: We have two papers in prospect relating to the solar eclipse of April 28, which presented several unusual features. These will be published in the next two issues. [Ed.]